The ESCAPE multi-centre evaluation of the role of chest pain units in the NHS

Report for the National Co-ordinating Centre for NHS Service Delivery and Organisation R & D (NCCSDO)

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The ESCAPE trial of chest pain units

Contents

List of contributors................................................................. 5
Acknowledgements..................................................................... 7
Funding......................................................................................... 7
Abbreviations used ....................................................................... 7

Executive summary

Background.................................................................................... 8
Objectives....................................................................................... 8
Methods ......................................................................................... 8
Results ........................................................................................... 9
Limitations....................................................................................... 10
Recommendations for NHS policy............................................... 10
Conclusion ..................................................................................... 11

The Report

Section 1 Background, aims and objectives ............ 12
1.1 The chest pain unit (CPU)..................................................... 13
1.2 Previous studies of CPU care............................................. 13
1.3 Rationale for the investigation........................................... 15
1.4 Aims and objectives.......................................................... 15

Section 2 Main study methods ............................... 17
2.1 Recruitment and allocation of hospitals ....................... 17
2.1.1 Implementation of CPU care at the intervention sites .... 18
2.1.2 Service development at the control sites ..................... 19
2.2 Quantitative evaluation of CPU effectiveness............... 19
2.2.1 Study population ......................................................... 20
2.2.2 Outcomes ..................................................................... 20
2.2.3 Data collection ............................................................. 20
2.2.4 Sample size .................................................................. 22
2.2.5 Planned analysis ........................................................... 22
2.3 Evaluation of CPU acceptability ................................. 23
2.3.1 Aims and objectives ..................................................... 23
2.3.2 Design........................................................................... 23
2.3.3 Setting .......................................................................... 23
2.3.4 Participants................................................................. 23
2.3.5 Analysis ....................................................................... 24
2.4 Evaluation of CPU cost-effectiveness......................... 25
The ESCAPE trial of chest pain units

2.4.1 Outcomes .................................................................25
2.4.2 Costs .........................................................................27
2.4.3 Long-term costs and QALYs ........................................29
2.4.4 Modelling of cost-effectiveness ....................................30

Section 3 Recruitment, allocation and service development
................................................................................ 32
3.1 Service development at the CPU hospitals .......................33
3.2 CPU activity ..................................................................34
3.3 Service development at the control sites .........................37
3.4 Discussion ....................................................................38
3.5 Summary ......................................................................40

Section 4 Quantitative findings: CPU effectiveness .... 41
4.1 Routine emergency department attendance data ...............41
4.2 Total emergency department attendances ..........................42
4.3 Emergency department attendances with chest pain .........42
4.4 Emergency department re-attendances and (re-)admissions ....46
4.5 Emergency medical admissions .......................................48
4.6 Change in outcome measures at individual CPU hospitals ....50
4.7 Emergency department waiting times .............................52
4.8 Thrombolysis audit data .................................................53
4.9 Questionnaire responses ...............................................56
4.10 Health utility ..............................................................58
4.11 Patient satisfaction .....................................................58
4.12 Summary ....................................................................60

Section 5 Qualitative findings: CPU acceptability .... 61
5.1 Interviews .......................................................................61
5.2 Findings ........................................................................64
  5.2.1 The chest pain pathway ..............................................64
5.3 Discussion .....................................................................76
  5.3.1 Chest pain experience and health care seeking ..........76
  5.3.2 Specialist nurse care ...............................................77
  5.3.3 Length of stay .........................................................78
  5.3.4 Information ...........................................................78
  5.3.5 Diagnosis and aftercare ............................................79
  5.3.6 Strengths and weaknesses ......................................80
  5.3.7 Implications for practice and research ......................80
5.4 Conclusions ..................................................................81

Section 6 Economic analysis: CPU cost-effectiveness82
6.1 Effectiveness ...............................................................82
6.2 Resource use ..............................................................83
6.3 Direct CPU costs .........................................................85
6.4 Costs per patient .........................................................85
6.5 Cost-effectiveness analysis ..........................................85
The ESCAPE trial of chest pain units

6.6 Limitations of the economic analysis

6.7 Summary

Section 7 Organisational evaluation of CPU implementation

7.1 Aim

7.2 Method

7.2.1 Sample

7.2.2 Data collection

7.2.3 Data analysis

7.2.4 Input-process-output model

7.3 Findings

7.3.1 Inputs

7.3.2 Process

7.3.3 Outputs

7.4 Discussion

7.4.1 Characteristics of higher-activity sites

7.5 Conclusions

7.5.1 Limitations

7.5.2 Recommendations

Section 8 Discussion

8.1 Comparison with previous studies of CPU care

8.2 Previous studies of other interventions to reduce emergency admissions

8.3 Organisational factors influencing CPU activity

8.4 Triangulation of quantitative and qualitative findings

8.5 Limitations of this study

8.6 Recommendations for NHS policy and practice

8.7 Future research

References

Appendices

Appendix I EQ5D health questionnaire

Appendix II Patient satisfaction

Appendix III Resource use
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The ESCAPE trial of chest pain units

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The ESCAPE trial of chest pain units

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Abbreviations used

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACS</td>
<td>acute coronary syndrome</td>
</tr>
<tr>
<td>A&amp;E</td>
<td>Accident and Emergency</td>
</tr>
<tr>
<td>CCU</td>
<td>coronary care unit</td>
</tr>
<tr>
<td>CHD</td>
<td>coronary heart disease</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>CPU</td>
<td>chest pain unit</td>
</tr>
<tr>
<td>ECG</td>
<td>electrocardiogram</td>
</tr>
<tr>
<td>ESCAPE</td>
<td>Effectiveness and Safety of Chest Pain Assessment to Prevent Emergency Admission</td>
</tr>
<tr>
<td>GP</td>
<td>general practitioner</td>
</tr>
<tr>
<td>HRG</td>
<td>Healthcare Resource Group</td>
</tr>
<tr>
<td>IQR</td>
<td>interquartile range</td>
</tr>
<tr>
<td>QALY</td>
<td>quality-adjusted life year</td>
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<tr>
<td>SHO</td>
<td>senior house officer</td>
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Executive summary

Background

Acute chest pain is responsible for approximately 700,000 patient attendances per year at emergency departments in England and Wales and 20–30% of emergency medical admissions. The chest pain unit (CPU) provides nurse-led, protocol-driven care for patients with acute chest pain, consisting of rapid blood testing for myocardial infarction (heart attack), followed by an exercise treadmill test. Previous studies suggest that CPU care reduces hospital admissions and re-attendances, improves patient satisfaction and quality of life, and may reduce health service costs. We aimed to determine whether CPU care is acceptable to patients and is more effective and cost-effective than routine care, and thus whether CPU care should be established throughout the NHS.

Objectives

Our specific objectives were to:

1. measure the effectiveness of CPU care, in terms of the proportion of patients with chest pain admitted to hospital, the proportions re-attending hospital and being (re-)admitted, the daily number of emergency medical admissions, time delays to treatment for myocardial infarction, emergency department waiting times, patient satisfaction with care and quality of life;

2. measure the cost-effectiveness of CPU compared with routine care, in terms of health service costs, quality-adjusted life years (QALYs), and the incremental cost per QALY gained;

3. explore, from the perspective of the patient, how the experience of chest pain assessment provided by CPU care compares with that provided by routine care;

4. identify the organisational factors that determine CPU activity.

Methods

We undertook a cluster-randomised controlled trial of 14 hospitals in which seven were allocated to establish CPU care and seven to continue providing routine care. Evaluation consisted of four elements, as follows.

1. Quantitative evaluation of effectiveness involved measuring outcomes at all hospitals over 1 year before and 1 year after intervention to determine the
**The ESCAPE trial of chest pain units**

Effect of establishing CPU care compared to control hospitals. Outcomes were measured using routine data sources (chest pain attendances, hospital admissions, time delays to treatment and waiting times) and postal questionnaire to a subgroup of 200 patients with chest pain before and 200 after intervention (patient satisfaction, quality of life and resource use).

1 Economic evaluation involved modelling data from the trial along with data from other sources to estimate the comparative costs and effects of CPU versus routine care, and the incremental cost per QALY of CPU care compared to routine care.

2 Qualitative evaluation of acceptability involved undertaking semi-structured, face-to-face interviews with 14 patients receiving CPU care at the intervention sites and 12 patients receiving routine care at the control sites. Data were analysed using the 'framework' approach.

3 Organisational evaluation used case-study methodology, involving semi-structured interviews and self-complete questionnaires to hospital staff, to identify the inputs, processes and outcomes that influenced CPU development at six CPU hospitals.

**Results**

CPUs were set up at all seven allocated hospitals, although activity levels varied between one and seven patients receiving the full CPU protocol per 1000 emergency department attendances.

CPU care was associated with:

1 weak evidence ($p=0.08$) of an increase in the proportion of emergency department attendances with chest pain;

2 a small reduction in the proportion of attendances with chest pain resulting in admission (odds ratio (OR) 0.942, 95% confidence interval (CI) 0.892–994, $p=0.029$), which was not significant after adjustment for confounding by age and gender (OR=0.998, 95% CI 0.940–1.059, $p=0.945$);

3 a small increase in re-attendances (OR=1.10, 95% CI 1.00–1.21, $p=0.036$) and (re-)admissions (OR=1.30, 95% CI 0.97–1.74, $p=0.083$);

4 an increase in mean daily emergency medical admissions (1.7 per day, 95% CI 0.8–2.5, $p<0.001$), both via the emergency department admissions (1.0 per day, 95% CI 0.4–1.5, $p=0.001$) and via other routes (0.6 per day, 95% CI –0.1 to 1.3; $p=0.078$), although these findings were highly sensitive to changes in the method used to handle missing data;

5 a decrease in total emergency department waiting time (relative effect 0.91, 95% CI 0.87–0.94, $p<0.001$) and no significant difference in waiting time to see a treating clinician (relative effect 1.01, 95% CI 0.96–1.07, $p=0.730$);

6 no significant difference in door-to-needle times (relative effect 1.07, 95% CI 0.90–1.27, $p=0.458$), call-to-needle times (relative effect 0.98, 95% CI 0.87–1.11, $p=0.781$), or onset-to-needle times (relative effect 1.03, 95% CI 0.87–1.22, $p=0.733$);
The ESCAPE trial of chest pain units

7 no significant difference in quality of life of over 6 months (absolute difference 0.0084 QALYs, 95% CI –0.0168 to 0.0337, \( p=0.512 \));

8 no significant change in any dimension of patient satisfaction;

9 no significant change in any item of resource use.

Economic modelling suggested that CPU care was associated with a non-significant increase in effectiveness of 0.0075 QALYs per patient (95% CI –0.0179 to 0.0322) and a non-significant cost decrease of £32 per patient (95% CI –399 to 467). Cost-effectiveness estimates were surrounded by substantial uncertainty with a 39.1% probability that CPU dominates routine care and an 11.8% probability that routine care dominates CPU.

Qualitative evaluation showed high levels of patient satisfaction with care in all hospitals, although there were individual differences between experiences of chest pain, access to care and care delivery. No clear distinction could be made between CPU and routine care on the basis of patient experiences. Aspects of care emerged that were important to patients in terms of quality: continuous access to specialist nurses helps meet the individual needs of patients; length of stay is extended in some cases by use of the CPU protocol and reduced nurse autonomy; and specific information and aftercare requirements of patients, particularly those with non-cardiac chest pain or diagnostic uncertainty, need to be addressed.

Organisational analysis suggested that variations in CPU activity may be associated with some of the following factors: whether ‘primed’ by previous similar initiatives, the nature of the relationships between key staff and departments, continuity of staffing in the CPU and its host department, how leadership of the service is expressed, the climate for change and innovation, clarity of roles, an ability to act proactively by the CPU nurses, and the presence or absence of one or more persons with clear responsibility and enthusiasm for driving the activity of the CPU.

Limitations

The structure, activity and outcomes of the CPUs varied substantially, and the effect of CPU care may have been diluted among the large number of patients with chest pain, most of whom did not receive CPU care. We cannot therefore conclude that any specific CPU is ineffective, or exclude the possibility of benefit to specific patient groups.

Recommendations for NHS policy

CPU care should not be established throughout the NHS. We found no clear evidence of benefit and some evidence that introducing CPU care may be associated with increased chest pain attendances and hospital admissions. This has implications for other service developments aimed at reducing emergency admissions. Evaluation of new services should include all potential users of these
The ESCAPE trial of chest pain units

services, not just the target population, to determine whether their introduction is associated with the generation of increased demand.

Chest pain attendances are rising and qualitative evaluation identified shortcomings in chest pain care, so new chest pain services need to be developed. Organisational factors were influential in determining CPU activity, which may in turn explain the lack of apparent effect. Future developments therefore need to consider the feasibility of implementation in a range of settings and to draw upon our findings to develop an optimal strategy for implementation.

Conclusion

We found no evidence that CPU care was any more effective or cost-effective than routine care, but may have been associated with increased attendances with chest pain. Continued attention needs to be given to improving care for this group of patients.
The ESCAPE trial of chest pain units

The Report

Section 1  Background, aims and objectives

Acute chest pain is responsible for approximately 700,000 patient attendances per year at emergency departments in England and Wales (Goodacre et al., 2005) and 20–30% of emergency medical admissions (Capewell, 1996). Acute coronary syndrome (ACS) is a common, potentially life-threatening cause of acute chest pain. ACS is caused by a blood clot forming in one of the blood vessels supplying the heart, leading to heart damage and the risk of death. In most cases patients with ACS are likely to benefit from hospital admission and treatment. It has been estimated that inappropriately discharging a patient with ACS to home results in an approximate doubling of mortality compared to admission and treatment (Pope et al., 2000). In addition, in some cases of ACS (such as those with ST-elevation myocardial infarction), breaking down the blood clot with drugs (thrombolysis) or removing it with a catheter (angioplasty) will improve outcomes, but these treatments are only effective if given quickly. These factors mean that patients with acute chest pain require rapid and accurate assessment for ACS. Recently developed rapid-access chest pain clinics cannot provide this and specifically exclude patients in whom ACS is suspected.

Investigations into acute chest pain in the UK suggest that the care provided to these patients is variable and often sub-optimal. A recent survey of emergency department management of acute chest pain (Goodacre et al., 2003) found that few departments had comprehensive guidelines for practice, there was little consistency in the use of diagnostic technologies, and estimated admission rates varied from 20 to 80%. Collinson et al. (2000) estimated that 8% of patients discharged home from the emergency department after assessment for acute chest pain had prognostically significant myocardial damage. Meanwhile, despite the strong national focus upon reducing times to thrombolysis for ST-elevation myocardial infarction (Department of Health, 1999), many hospitals are not achieving targets (Rhodes et al., 2002).

Effective management of patients with acute chest pain requires rapid and appropriate triage, so that those with ST-elevation myocardial infarction receive rapid thrombolysis or angioplasty, those with other forms of ACS receive hospital admission and treatment and those without ACS are discharged home with appropriate reassurance and advice (Department of Health, 1999). However, clinical assessment in isolation has limited diagnostic value (Panju et al., 1998) and routine emergency department testing with electrocardiogram (ECG) and chest X-ray cannot rule out ACS, so it is not surprising that routine emergency department assessment of acute chest pain is often sub-optimal. The scale of this problem is likely to grow. National guidance (Department of Health, 1999) states that patients calling their general practitioner (GP) or NHS Direct with acute chest pain of possible cardiac origin should be referred to hospital by
The ESCAPE trial of chest pain units

emergency ambulance, while a recent campaign by the British Heart Foundation has encouraged the public to seek emergency medical help if they experience chest pain.

1.1 The chest pain unit (CPU)

The chest pain unit (CPU) is an innovative method of service delivery that is designed to improve management of acute chest pain (Clancy, 2002). Although typically described as a unit the CPU is more accurately considered as a system of care, rather than necessarily as a distinct physical entity. Care is protocol-directed, may be provided by specialist chest pain nurses, and typically includes the following elements (Goodacre, 2000).

1. Immediate ECG recording upon arrival at hospital to detect diagnostic changes for ACS.

2. The use of validated clinical predictors to select patients for further diagnostic testing.

3. Short-stay observation and biochemical cardiac testing to rule out prognostically significant cardiac damage.

4. Exercise treadmill testing to provide further diagnostic and prognostic information for those patients with no ECG or biochemical evidence of cardiac damage.

The CPU is thus designed to improve care for patients with acute chest pain in the following ways.

1. Rapid ruling out of ACS allows patients to be discharged home, thus reducing unnecessary hospital admissions.

2. Accurate identification of ACS avoids inappropriate discharge of patients with ACS.

3. Improved diagnostic certainty can reduce patient anxiety and improve satisfaction with care.

4. Appropriate use of hospital resources, particularly inpatient beds, can improve the cost-effectiveness of care.

Use of a CPU may have other positive knock-on effects for emergency care. For example, rapid assessment of patients with chest pain may reduce delays to thrombolysis for those with ST-elevation myocardial infarction and accelerated patient throughput may reduce overall emergency department waiting times.

1.2 Previous studies of CPU care

A systematic review of the CPU literature published in 2000 found that most studies originated from the USA (Goodacre, 2000). Randomised trial evidence showed that CPU care was cost-saving compared to inpatient care in the USA (Gomez et al., 1996; Roberts et al., 1997; Farkouh et al., 1998), whereas non-randomised evidence showed that CPU care could reduce the risk of inadvertent discharge of patients with ACS (Graff et al., 1997). Evaluation from the patient’s perspective was limited to one study, showing increased patient satisfaction associated with CPU care (Rydman et al., 1997). These data have led to CPU
The ESCAPE trial of chest pain units

care becoming widespread in the USA, where it is now promoted and units are accredited by a national organisation, the Society for Chest Pain Centers (www.scpcp.org/).

Since 2000 there have been a number of studies evaluating CPU care in the UK. A diagnostic protocol using 3–6 hours of ECG monitoring and rapid cardiac marker testing, without exercise testing, was shown to accurately detect ACS at the Manchester Royal Infirmary (Herren et al., 2001). Early exercise testing was shown to be feasible at the Royal United Hospital in Bath (Taylor et al., 2002). Meanwhile, at the Northern General Hospital in Sheffield, a protocol consisting of up to 6 hours of ECG monitoring and rapid cardiac marker testing, followed by an immediate exercise treadmill test, was shown to be safe and practical (Goodacre et al., 2002).

The Sheffield CPU has been evaluated by a single-centre cluster-randomised controlled trial (Goodacre et al., 2004a) comparing CPU care to routine care by randomising days of the week to the CPU being either open or closed. CPU care reduced the admission rate from 54 to 37% without increasing the rate of inappropriate discharge with ACS, and was associated with significant improvements in health utility, quality of life, psychological symptoms and patient satisfaction. Economic evaluation found a non-significant reduction in health service costs associated with CPU care and showed that there was a high probability that even if CPU care were more expensive than routine care it would represent a cost-effective use of NHS resources at current values of willingness to pay for health gain (National Institute of Clinical Excellence, 2004).

These results show that CPU can be an effective health technology that has the potential to reduce costs and improve outcomes throughout the NHS. However, the study has a number of limitations, as listed here.

1 The setting for the trial may not be typical of the NHS. The Northern General Hospital Emergency Department has a special interest in chest pain and, being the only adult emergency department serving the 530,000 people of Sheffield, may receive more attendances with acute chest pain than any other department in the UK.

2 Patient selection meant that the trial only examined the effect of CPU care upon the specific group of patients for which the CPU was designed. We do not know whether the CPU had other potentially negative effects upon other patients with chest pain.

3 Improvements in patient satisfaction and quality of life may be explained partly by patients being aware that they were receiving innovative management, or not receiving it in the case of the control group.

4 Conversely, the effect of CPU care may have been underestimated because of contamination of the control group; that is, on days when the CPU was not operational departmental practice may have followed CPU protocols.

5 The quantitative evaluation used in the trial only provided a limited evaluation of the patients’ perspective of CPU care.
**The ESCAPE trial of chest pain units**

### 1.3 Rationale for the investigation

Establishing CPU care across the UK may require a similar degree of funding to the £50 million required to establish rapid-access chest pain clinics and would then require recurrent funding to maintain the service. This may prove to be money well spent if CPU lives up to its promise to improve outcomes and save NHS costs by reducing hospital admissions, but may be wasted if the findings of the single-centre study are not consistently reproduced in other hospitals. The process of establishing CPU care at a number of different hospitals therefore was in need of evaluation and comparison with hospitals where chest pain services develop without implementing CPU care. This would allow us to determine whether CPUs should be established at all NHS hospitals.

CPU care is intended to reduce hospital admissions (without increasing the proportion of patients inappropriately discharged with ACS), reduce times to thrombolysis, improve patient health, and improve patient satisfaction. These outcomes should be measured at an organisational level to achieve a naturalistic model of CPU service delivery, to reduce awareness among CPU and control patients that they are receiving ‘innovative’ and ‘routine’ care respectively, and to avoid contamination of the control group (i.e. copying CPU care).

Even if CPU care were shown to be effective, it may not be acceptable to health service users. Acceptability is likely to depend upon many factors that are not measured by quantitative methods, such as whether individual patients regard avoiding hospital admission as potentially beneficial or harmful to them, whether nurse-led or protocol-driven care is acceptable, whether short-stay, observation care is acceptable, and whether intensive early diagnostic testing really does lead to increased diagnostic certainty for the individual patient.

### 1.4 Aims and objectives

We aimed to evaluate whether CPUs provide a system of care for emergency patients with acute chest pain that is effective, acceptable, and cost-effective, compared with routine emergency care.

Our specific initial objectives were to determine:

1. whether introducing CPU care reduced hospital admissions across a number of typical NHS settings without increasing the risk of inadvertent discharge with ACS;
2. the effect of CPU availability upon time delays (symptom onset-, call- and door-to-needle times) for thrombolysis;
3. the effect of CPU availability upon the number of emergency medical admissions and waiting times in the emergency department;
4. the effect of CPU care upon satisfaction with care and health utility of patients with acute chest pain;
5. from the perspective of the patient, how the experience of chest pain assessment provided by CPU care compares with that provided by routine care;
The ESCAPE trial of chest pain units

6 the incremental cost per quality-adjusted life year (QALY) gained by CPU compared with routine care.

We subsequently developed an additional objective as a result of our observations during development of CPU care: to identify the organisational factors that influence the implementation of CPU care.
Section 2 Main study methods

We planned to evaluate the effectiveness, acceptability and cost-effectiveness of CPU care using a cluster-randomised controlled trial in which hospitals were allocated randomly to either establish CPU care or continue with routine non-CPU care. The planned evaluation consisted of three elements, as follows.

1 Quantitative evaluation of effectiveness involved measuring outcomes at all hospitals before and after intervention to estimate the effect of establishing CPU care compared with routine care, while controlling for baseline differences between hospitals allocated to CPU and routine care.

2 Qualitative evaluation of acceptability involved undertaking semi-structured, face-to-face interviews with patients receiving CPU care at the intervention sites and patients receiving routine care at the control sites.

3 Economic evaluation involved modelling data from the trial along with data from other sources to estimate the incremental cost per QALY of CPU care compared with routine care.

In addition to the planned evaluation, we undertook an organisational study of six hospitals that established CPU care in the trial. It became apparent during the main study that the CPUs varied substantially in their structure, processes and number of patients managed. We therefore decided to explore the reasons for this variation systematically.

Methods for the main study are outlined in this section, with results in Sections 4, 5 and 6, and the organisational study is described in its entirety in Section 7.

2.1 Recruitment and allocation of hospitals

We planned to recruit 18 hospitals and randomly allocate nine to establish CPU care and nine to continue with routine care. Hospitals willing to participate were sought by advertising the trial at conferences, by email contact with consultants in emergency medicine through the British Association of Emergency Medicine email list, and via the Coronary Heart Disease and Emergency Services collaboratives.

To be eligible to participate, the hospital needed to meet the following criteria:

1 an acute hospital accepting emergency attendances and admissions with acute chest pain;

2 adequate data-collection systems to allow identification of cases with acute chest pain, numbers of emergency medical admissions and emergency department waiting times;

3 an ongoing programme of thrombolysis audit, preferably by participation in the Myocardial Infarction National Audit Project (MINAP);

4 no currently established CPU or system of care closely resembling a CPU according to our definition;
The ESCAPE trial of chest pain units

5 potential to establish a CPU; that is, the ability to employ chest pain nurses, develop short-stay observation facilities and provide access to exercise treadmill testing;

6 willingness to allow the process of CPU set-up to be determined by random allocation.

If a hospital could meet these criteria they were asked to provide a letter from a member of senior management confirming that they would establish a CPU (or not) according to the randomisation process. They were also asked, before the results of random allocation were revealed, to set a date upon which they would commence CPU care (allowing a 1-month run-in period) if they were randomised to do so. This date would be the intervention date for determining pre- and post-intervention time periods at both CPU and control hospitals.

Hospitals were recruited consecutively as soon as they were able to make the necessary commitment. Once a pair of hospitals were recruited they were randomly allocated, one to establish CPU care, the other to continue with routine care. The randomisation process was controlled by a researcher at the University of Sheffield who was not associated with the trial. None of the trial researchers were aware of the randomisation process. Once randomised, hospitals were considered to be irreversibly entered into the trial and allocated to their intervention group, regardless of whether they actually established CPU care. The intervention date set prior to randomisation was used to determine pre- and post-intervention periods, regardless of whether CPU care was actually commenced on that date.

2.1.1 Implementation of CPU care at the intervention sites

We intended that the process of implementing CPU care should be naturalistic and resemble service development rather than research, while recognising the need to overcome potential barriers to implementation. A local Lead Clinician who was a consultant in either emergency medicine or cardiology was identified at each hospital to lead implementation, along with key staff members who would be required to support the unit. These included emergency department and cardiology medical and nursing staff, cardiology technicians, laboratory staff and hospital managers.

We appointed a full-time Clinical Manager for the trial (JA) who was responsible for supporting the hospitals in implementing CPU care. The Clinical Manager had previously worked as a chest pain nurse on the Sheffield CPU and was able to provide expertise in, and experience of, setting up and running a CPU. She was assisted by a member of the Research Team (FM) who is a senior emergency department physician and was responsible for establishing the Sheffield CPU.

Two teaching days took place at all intervention sites prior to commencing and ad hoc days were arranged as the sites requested or thought necessary throughout the trial year. Protocols and data-collection forms were provided by the researchers. Once the intervention year had commenced, regular visits took place by the research staff to ensure that hospitals were working safely within the protocol. At any other time all hospitals were able to contact a member of the research team by telephone to discuss any problems. However, ultimate responsibility for CPU operation and performance was with the participating
The ESCAPE trial of chest pain units

hospital, rather than the Effectiveness and Safety of Chest Pain Assessment to Prevent Emergency Admission (ESCAPE) researchers.

Funding for the initial set-up costs of the CPU had to be found by the individual hospitals, but it was expected that these costs would be recouped during the trial year by means of a central subvention from the UK Department of Health. Under this arrangement the hospital was reimbursed £106 per patient managed according to the CPU protocol. This sum was estimated from the Sheffield trial to be the excess per-patient cost of providing CPU care, not allowing for any potential cost savings from CPU care.

To monitor CPU performance we asked CPU staff to record presenting details, diagnostic test results and management decisions for all patients managed according to the CPU protocol. Other patients, such as those with acute myocardial infarction or unstable angina, who might have been occasionally or opportunistically managed by CPU staff or using CPU facilities were not recorded routinely. All patients discharged from the CPU were checked on the hospital system by the Clinical Manager for any re-attendances with a chest pain-related complaint or any adverse event. These were defined as subsequent admission to hospital for more than 48 hours, deaths or non-fatal myocardial infarction.

The CPU was ideally expected to have the following features:
• based in or adjacent to the emergency department,
• staffed by specialist chest pain nurses,
• biochemical tests available in laboratories with a turnaround time of 1 hour,
• availability of a treadmill test immediately following observation, performed on a machine in the emergency department by chest pain nurses.

However, to allow CPU care to be set up in a variety of settings, we accepted the following variations to the preferred model:
• based on an observation or admissions ward,
• cross-cover for chest pain nurses by other staff,
• point-of-care biochemical tests,
• discharge home between biochemical tests and treadmill test (but treadmill must be next working day),
• treadmill test in cardiac department.

2.1.2 Service development at the control sites

Hospitals allocated to continue with routine care were asked not to set up a CPU or introduce any of the specific elements of CPU care, such as short-stay observation with biochemical testing or rapid exercise treadmill testing, but were free to continue with normal service development, such as audit of thrombolysis times and staff development.

2.2 Quantitative evaluation of CPU effectiveness

We used a randomised controlled before-and-after intervention study design. Outcomes were measured over 1 year at all hospitals. CPU care was then
The ESCAPE trial of chest pain units

established at randomly allocated hospitals and outcomes measured again at all hospitals over the following year. To ensure that CPU development and routine care remained as naturalistic as possible, all outcome measures were recorded from either routine data or follow-up patient questionnaire so that they did not affect day-to-day patient care.

2.2.1 Study population

The main study population consisted of all adult patients identified as presenting with chest pain or a related complaint (such as angina or suspected heart attack) during the year before and the year after intervention. Research staff retrospectively identified the study population from the hospital computer database using a predefined list of presenting complaints.

2.2.2 Outcomes

We planned to measure the following outcomes.

1. The proportion of adult patient attendances with chest pain that resulted in admission to hospital after emergency department assessment (primary outcome).
2. The proportion of adult patients attending with chest pain that re-attended within 30 days of initial attendance (re-attendances), and the proportion that were admitted when they re-attended. We refer to the latter group of patients as (re-)admissions to differentiate them from admissions at initial attendance while recognising that they may have been admitted or discharged at initial attendance.
3. The 30-day adverse event rate among patients discharged home after emergency department assessment for chest pain, defined as cardiac and non-cardiac death, myocardial infarction, life-threatening cardiac arrhythmia, new-onset heart failure or hospital admission for more than 48 hours.
4. Daily number of adult emergency medical admissions arriving via the emergency department and arriving via other routes.
5. Emergency department waiting times to see a treating clinician (doctor or nurse practitioner) and total departmental waiting time (all emergency department patients, not just those with chest pain).
7. Health utility at 1 and 6 months.
8. Patient satisfaction with care.

2.2.3 Data collection

We collected outcomes 1–5 from hospital computer databases, augmented by case notes where appropriate. Research staff scanned all emergency department attendances recorded on the patient information system database during the trial years and selected all chest pain-related attendances. The primary outcome
The ESCAPE trial of chest pain units

was then classified using the ‘disposal’ category recorded for each patient. Deaths and transfers to other hospitals were categorised as admissions. Self-discharges, leaving without being seen and referrals to other non-hospital agencies were classified as discharges. Missing or other disposal categories were classified as unknown outcome. These data were used to assess outcome 1.

We scanned all chest pain-related attendances in the pre-intervention and post-intervention years separately to identify multiple attendances by the same person in each year. The first attendance by each person was recorded and used to provide the denominator for outcomes 2 and 3. We then scanned all emergency department attendances to identify any re-attendances within 30 days of the first attendance by each person. If a re-attendance was identified the disposal category was assessed as described above to determine whether the re-attendance resulted in (re-)admission.

We planned to collect further data from patients who were re-admitted after being discharged at initial attendance to identify adverse events. Unfortunately, hospital data-collection systems proved inadequate to accurately achieve this aim within an acceptable time frame. Admission diagnoses and length of stay were inconsistently recorded on computer data systems, while case notes could not be retrieved rapidly. We therefore limited evaluation of this outcome to identifying cases that were (re-)admitted within 1 month after initially being discharged, excluding those who clearly were not (re-)admitted with a chest pain-related cause (on the basis of their presenting complaint at re-admission).

Daily emergency medical admissions were identified from hospital patient information systems over the two study years. We identified all specialties that could potentially have accepted adult patients with acute chest pain as an emergency medical admission (general medicine, elderly medicine, cardiology, thoracic/respiratory medicine and gastroenterology) and then classified admissions as being via the emergency department or via other routes (direct admission from GP, outpatient clinic, consultant referral or other community source).

Emergency department waiting time data were collected for all attendances (not just those related to chest pain) from hospital patient-information systems. Department of Health targets require all hospitals to record patient time of arrival in the emergency department, time of initial assessment by a treating clinician and time of departure from the emergency department. We used these data to calculate the time delay to seeing a treating clinician and the total time spent in the department. We randomly selected 1000 cases from the year before and 1000 cases from the year after intervention for analysis.

Thrombolysis time data, outcome 6, were collected by participating hospitals through routine thrombolysis audit of patients with myocardial infarction, usually via the Myocardial Infarction National Audit Project. This national audit, run by the Royal College of Physicians, requires hospitals to collect standardised data from all cases of myocardial infarction, including time of symptom onset, time of call to emergency services, time of arrival at hospital and time at which thrombolysis was initiated. We selected cases that received thrombolysis for ST-elevation myocardial infarction and calculated time delays from symptom onset to thrombolysis (onset to needle), emergency call to thrombolysis (call to
The ESCAPE trial of chest pain units

needle) and hospital arrival to thrombolysis (door to needle). Some hospitals developed pre-hospital thrombolysis and primary angioplasty for ST-elevation myocardial infarction during the study period. Patients receiving pre-hospital thrombolysis were included in the analysis, potentially with negative door-to-needle times. Patients receiving primary angioplasty were excluded.

Outcomes 7 and 8 were collected through the postal questionnaire survey. We selected a sample of 200 consecutive patients with chest pain or a related complaint before and after the intervention date at each site. Those who were not identified as having died were sent a postal questionnaire 1 month after their initial attendance consisting of the EQ-5D health utility index, a patient-satisfaction questionnaire and a resource-use questionnaire. Copies of the questionnaires are shown in Appendices I–III. The patient-satisfaction questionnaire was developed from the Group Health Association of America (GHAA) Consumer Satisfaction Survey and has been used in previous evaluations of emergency care. Each question uses a 5-point Likert scale in which scores of 1–5 correspond to ratings of poor, satisfactory, good, very good and excellent.

Potential participants were asked to provide written consent to participate along with their completed questionnaire. They were asked to return the documentation without completing if they did not wish to participate. Two re-mailings were sent to non-responders. Respondents to the questionnaire were sent a further postal questionnaire consisting of the EQ-5D and resource-use questionnaire 6 months after initial attendance. All documents in the initial mailing were in English, but a covering statement explained the nature of the correspondence in Urdu, Bengali, Hindi, Gujarati, Punjabi and Chinese, and offered fully translated documents if the potential participant ticked the appropriate language and returned the covering statement.

2.2.4 Sample size

We anticipated that each hospital would see approximately 4200 attendances per annum with chest pain or a related complaint. Using standard sample-size calculations, we estimated that a sample of 890 attendances in each hospital before, and 890 after intervention, would have 80% power to detect an absolute difference of 5% in the proportion resulting in admission (α=0.05). This assumed that the primary outcome was not clustered by hospital. There was no strong theoretical reason to expect significant clustering and data from the Sheffield trial showed no evidence of clustering by day. However, the sample size allowed for the possibility of clustering with a design effect of up to 4.

2.2.5 Planned analysis

For each hospital, the change in each outcome between the pre- and post-intervention years was calculated and the changes recorded in intervention and control hospitals were then compared. A random-effects multi-level model was then used, with the individual hospital attended as a random effect and age, gender, hospital allocation (CPU or control) and time (before or after intervention) as covariates. This was used to test the hypothesis that CPU availability was associated with a significant effect upon outcome and to estimate
The ESCAPE trial of chest pain units

The effect of introducing CPU care. Analysis was performed on an intention-to-treat basis, with attendances or patients being coded according to the initial allocation of the hospital to CPU or control, regardless of whether they actually received CPU care.

Binary outcome measures (1–3) were analysed using random-effects logistic regression to estimate the adjusted odds ratio for the effect of CPU availability. Continuous outcome measures that were unlikely to be highly skewed (4, 7 and 8) were analysed using raw data in a random-effects regression model to estimate the absolute effect of CPU availability. Outcomes measuring time delay (5 and 6) were log-transformed and then analysed in a random-effects model. The resulting coefficient and confidence interval were back-transformed to estimate the relative effect of CPU availability upon the median time delays (i.e. the ratio of the median time with CPU care to the median time with routine care). For potentially skewed economic measures (length of stay and costs) we assumed that the sample size was sufficient for the central limit theorem to hold and used untransformed data in the analysis.

2.3 Evaluation of CPU acceptability

We planned to undertake face-to-face semi-structured interviews with patients attending hospital with acute chest pain to explore the acceptability of CPU care in comparison with routine care.

2.3.1 Aims and objectives

This part of the study aimed to explore patient views and experiences of either the care received in a CPU or with routine care in the emergency department. We wanted to gain an understanding of how chest pain and consequent care were perceived by patients. In particular, we were interested in the acceptability of services, in order to inform service development.

2.3.2 Design

We planned to undertake up to 36 face-to-face, semi-structured interviews with patients who had attended hospital with acute chest pain, within 4 weeks of hospital attendance. The option of telephone interviews was subsequently added to accommodate people who had daytime commitments.

2.3.3 Setting

Seven of the participating hospitals were asked to take part in the study, based on intervention status, accessibility and length of time remaining on the trial. Four of the hospitals had been randomised to establish CPU care and three to continue providing routine care.

2.3.4 Participants

We aimed to interview people who had experience of acute chest pain of unknown origin at the time of hospital assessment. Emergency department
The ESCAPE trial of chest pain units

Consultants and specialist cardiac nurses approached patients during their stay in hospital to explain the study and invite them to take part. Information packs containing an explanatory letter, information leaflet, reply slip, and pre-paid envelope addressed to the researcher were handed to patients that were interested in being interviewed.

Purposive sampling was used to enhance contrasts between CPU and routine care, and to explore the role of gender and risk of coronary heart disease (CHD). We planned to sample equal number of participants from hospitals with and hospitals without CPU care. We purposively sampled patients who had no clear diagnosis after initial emergency department assessment (i.e. before CPU or inpatient assessment), who were not admitted to hospital for more than 48 hours and who actually received CPU care, if they attended a hospital with a CPU. Sampling on the basis of gender and risk of CHD was used to ensure that these issues could be explored in both CPU and routine care settings.

Participants were asked to describe their general health, followed by their experiences of the chest pain episode from the onset of symptoms, through hospital care, to any reflections after discharge. Particular areas of probing were around expectations, care settings, interactions with health care professionals, the meaning of diagnostic interventions, access to information and discharge arrangements. Participants were also encouraged to raise issues that they felt were important, but had not been covered by the interview schedule.

2.3.5 Analysis

All the interview tapes were transcribed verbatim, with identifying words and phrases omitted. Transcripts were coded and stored separately from participant information. Data were managed and analysed using Framework (Ritchie and Lewis, 2003), a qualitative method developed specifically for policy research, with a step-by-step pragmatic approach that allows transparency and audit of the process. In the initial stage of the data collection, the researcher listened to tapes and read transcripts to become familiarised with, or immersed in, the data. The data were then coded into segments that addressed similar issues, attitudes or behaviours.

Patient experiences were seen as chronological; that is, the questions and narratives followed a pathway from onset of symptoms through to the interview. Data were thus organised initially into three sections: chest pain experience, experience of care and aftercare. Data within each of these sections were coded into sub-categories, such as symptoms, and health care seeking, which were scrutinised for links and patterns. For example, the patient experience may be affected by cross-cutting themes such as family history, age, gender, diagnosis and responsibilities. In addition, health beliefs and influences on health-related behaviour are often identifiable in the narratives, and these can be linked to actual or expected experiences. Relevant literature was used to inform later stages of the analysis, and findings compared with those of previous studies.
The ESCAPE trial of chest pain units

2.4 Evaluation of CPU cost-effectiveness

We previously developed a model of diagnostic strategies for acute chest pain that has shown that the CPU protocol appears to be a reasonable use of health service resources (Goodacre and Calvert, 2003). Economic evaluation of the Sheffield randomised controlled trial (Goodacre et al., 2004a) showed that CPU care was associated with a non-significant reduction in mean health service costs per patient and an acceptable upper 95% confidence interval for the cost per QALY for CPU, compared with routine care.

The ESCAPE multi-centre study was planned to develop the existing model and explore the generalisability of cost-effectiveness estimates across a variety of NHS settings. We used a health service costing perspective. Outcomes of CPU and routine care were modelled as QALYs, and costs measured as pounds sterling. The comparative costs and outcomes of CPU and routine care were estimated, along with the incremental cost per QALY of providing CPU care.

2.4.1 Outcomes

We assumed that CPU care could potentially change outcomes in three ways:

1. reducing death from myocardial infarction by reducing time to thrombolysis for patients with ST-elevation myocardial infarction;
2. reducing death from ACS by reducing the proportion of patients discharged with ACS;
3. improving quality of life for all patients by providing a more rigorous diagnostic assessment.

We modelled these three outcomes using the decision tree shown in Figure 1. This model applies to a population of patients attending hospital with acute chest pain, which is effectively the study population identified for evaluation of outcomes 1–3 in the quantitative study. The following assumptions have been built into the model.

1. A decision is made to manage patients either by a hospital with a CPU or one without (routine care).
2. A proportion of patients will have a ST-elevation myocardial infarction and will be eligible for thrombolysis. This proportion does not depend upon whether the hospital has a CPU or not, but may vary between individual hospitals.
3. A proportion of thrombolysed patients will die within 30 days. This proportion will depend upon whether the hospital has a CPU and whether CPU care affects time delays to thrombolysis.
4. A proportion of patients will have ACS and be inadvertently discharged without treatment. This proportion will depend upon whether the hospital has a CPU and whether CPU care affects the probability of inadvertent discharge with ACS.
5. Patients who are discharged with ACS will have an increased probability of dying, compared with those who are not discharged. This increased probability of dying is not dependent upon CPU care and does not vary between hospitals.
The ESCAPE trial of chest pain units

6 All patients who do not die will have quality of life over the next 6 months determined by whether they attended a hospital with CPU care or not. After 6 months survival and quality of life will be independent of care initially received.

Figure 1 The ESCAPE decision tree

For explanations of probability, cost and outcome parameters, please see Tables 2–4.

The model will thus allow us to estimate the incremental QALYs associated with providing CPU care. The data sources for the model parameters were as follows:

1 Proportion of chest pain patients who have ST-elevation myocardial infarction: we used study data to divide the number of cases thrombolysed for ST-elevation myocardial infarction by the total number of chest pain attendances.

2 Mortality from ST-elevation myocardial infarction at hospitals with no CPU: the Boersma equation (Boersma et al., 1996) has been derived from thrombolytic trial data to estimate the relationship between time delay from symptom onset to thrombolysis and expected probability of mortality for a typical patient. We used the Boersma equation to calculate expected mortality, according to their onset-to-needle time, for all patients thrombolysed for ST-elevation myocardial infarction in the study. Data from patients attending a hospital with no active CPU (i.e. pre-intervention at CPU hospitals and both time periods at control hospitals) were used to estimate the mortality of ST-elevation myocardial infarction when no CPU is available.

3 The effect of CPU care upon mortality from ST-elevation myocardial infarction: we used expected mortality data, calculated using the Boersma equation, to estimate the absolute effect of CPU care upon mortality. A random effects model was used to estimate the effect of CPU care compared to control hospitals, after adjusting for baseline difference between CPU and control hospital, along with age and gender.
**The ESCAPE trial of chest pain units**

4 Probability of being discharged with ACS at a hospital with no CPU: a study by Collinson et al. (2000), undertaken at a hospital without CPU care, found that eight patients out of 676 attending with chest pain were inadvertently discharged home with ACS. On this basis we estimated that 1.2% (95% confidence interval (CI) 0.6–2.3) of patients attending with chest pain will be discharged with ACS after attending a hospital with no CPU.

5 Estimated effect of CPU availability upon discharge with ACS: we identified all study patients who were discharged after initially attending with chest pain and then were admitted within 30 days with a complaint that was not obviously unrelated to chest pain. We then used random-effects modelling to estimate the effect of CPU availability upon this outcome, compared to control hospitals, while adjusting for baseline differences between CPU and control hospitals, age and gender. We assumed that the relative effect of CPU availability upon this outcome was equivalent to the effect of CPU availability upon discharge with ACS. We originally intended to estimate the effect of CPU care upon the adverse event rate after discharge, but hospital data systems proved inadequate to allow accurate identification.

6 The effect of inadvertent discharge upon ACS, compared to admission: we have previously used data from a variety of sources (Goodacre and Calvert, 2003) to estimate that inadvertent discharge with ACS results in a approximate doubling, or 3% absolute increase, in mortality.

7 QALYs up to 6 months after attending a hospital with no CPU available: we used EQ-5D data from the study at 1 and 6 months to estimate the area under the curve for health utility. Data from all patients who attended a hospital without an active CPU (i.e. pre-intervention at CPU hospitals and both time periods at control hospitals) were used to estimate QALYs up to 6 months.

8 Estimated effect of CPU availability upon QALYs up to 6 months: area-under-the-curve data for health utility were analysed using a random-effects regression model to estimate the absolute effect of availability of CPU care upon QALYs up to 6 months, compared with control hospitals, adjusted for baseline differences, age and gender.

9 Lifetime QALYs (after the initial 6 months): we estimated the number of discounted QALYs that an average patient would expect to accrue after a myocardial infarction using external data (see details below). This value was applied to all patients, regardless of the cause of their chest pain, because only those with myocardial infarction or ACS could potentially suffer mortality that would lead to a difference between the two branches of the tree. Lifetime QALYs for patients with non-cardiac chest pain would be the same in both arms of the decision tree, so the actual value attributed would not alter analysis.

### 2.4.2 Costs

The following items of resource use were identified:

1 initial emergency department attendance, CPU care, and hospital admission;

2 emergency department re-attendances, hospital (re-)admissions, outpatient visits, diagnostic tests, operations and procedures;
The ESCAPE trial of chest pain units

3 telephone health advice;
4 GP, nurse and social work visits;
5 loss of productivity;
6 long-term costs of care for excess survivors with CHD.

We did not include the basic cost of initial emergency department assessment in the analysis, but instead estimated the additional cost per patient of providing CPU care at the hospitals with an active CPU. Hospitals that set up a CPU were remunerated for the additional costs of providing CPU care by a central subvention from the Department of Health. This was set at £106 per patient managed according to the full CPU protocol based upon data from the Sheffield trial. Thus the total additional costs of providing CPU care were estimated to be 106 multiplied by the total number of patients attracting remuneration at each CPU hospital. We anticipated that this sum would be used to fund various elements of CPU care, such as CPU staff, that could potentially influence the management of all patients with chest pain.

Outcomes were measured across all patients with chest pain, rather than just those receiving the full chest pain protocol (or those eligible for the full chest pain protocol at hospitals without CPU, an undefined group). We therefore divided the total cost of supporting CPU care by the total number of patients with chest pain attending hospitals when a CPU was available to estimate the additional cost per chest pain patient of providing CPU care.

Items under 2–5 above were measured using a self-completion resource use questionnaire mailed to 200 randomly selected patients with chest pain at each site at 1 and 6 months after initial attendance. The questionnaire is shown in Appendix III and was sent along with the EQ-5D questionnaire and (at 1 month only) the patient-satisfaction questionnaire. Length of initial hospital stay was recorded from hospital records for all patients selected for questionnaire mailing. Long-term costs of care for the excess survivors with CHD were estimated from external data sources (see details below). As with lifetime QALYs, we used the same values for long-term costs of care for all patients (regardless of the underlying cause of their chest pain) because we assumed that only those with myocardial infarction or ACS would differ between the two strategies.

We valued resource items in the following ways.

1 Telephone health advice, GP surgery consultations, GP home visits, nurse home visits, social worker visits and emergency department attendances were valued using national estimates of unit costs for the relevant codes (Curtis and Netten, 2005).
2 We assumed all outpatient attendances were follow-up appointments and were valued according to the national estimate for Healthcare Resource Group (HRG) code 320 (cardiology; Department of Health, 2006).
3 Nights spent as a hospital inpatient were calculated using the weighted average of the national estimate for HRG codes E35 and E36.
4 Unit costs for diagnostic tests were obtained from national published estimates of the relevant HRG codes.
5 Cardiac procedures were valued using national estimates of unit costs for HRG codes E15 (PCI) and E04 (CABG).
The ESCAPE trial of chest pain units

The unit costs used are shown in Table 1. Total costs were then aggregated across patients to derive a total cost per patient. This included the additional cost of providing CPU care (see above) for all post-intervention patients attending a CPU hospital.

Table 1 Units costs used to value resource items

<table>
<thead>
<tr>
<th>Resource item</th>
<th>Unit cost (£)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP telephone advice</td>
<td>22</td>
<td>Curtis and Netten, 2005 (p. 141), per telephone consultation lasting 10.8 min</td>
</tr>
<tr>
<td>GP surgery consultations</td>
<td>20</td>
<td>Curtis and Netten, 2005 (p. 141), per surgery consultation lasting 10.0 min</td>
</tr>
<tr>
<td>GP home visits (assume 30 min)</td>
<td>96</td>
<td>Curtis and Netten, 2005 (p. 141), per home visit minute</td>
</tr>
<tr>
<td>Nurse home visits</td>
<td>19</td>
<td>Curtis and Netten, 2005 (p. 133), per home visit</td>
</tr>
<tr>
<td>Social worker visits</td>
<td>106</td>
<td>Curtis and Netten, 2005 (p. 135), per hour of face-to-face contact</td>
</tr>
<tr>
<td>Emergency department attendances</td>
<td>110</td>
<td>Curtis and Netten, 2005 (p. 115), cost per first attendance</td>
</tr>
<tr>
<td>Hospital outpatient attendances</td>
<td>97</td>
<td>HRG 2005 - TOPS FUA (320 cardiology)</td>
</tr>
<tr>
<td>Nights as hospital inpatient</td>
<td>488</td>
<td>HRG 2005 – TNELIP (weighted average E35, E36, chest pain)</td>
</tr>
<tr>
<td>Exercise tests</td>
<td>81</td>
<td>HRG 2005 – TCMTESTS (da04)</td>
</tr>
<tr>
<td>Echocardiograms</td>
<td>59</td>
<td>HRG 2005 - TCMTESTS (da02)</td>
</tr>
<tr>
<td>Radionuclide scans</td>
<td>335</td>
<td>HRG 2005 - TRADIO (rbj1)</td>
</tr>
<tr>
<td>Coronary angiograms</td>
<td>265</td>
<td>HRG 2005 - TRADIO (rbf2)</td>
</tr>
<tr>
<td>Endoscopies</td>
<td>226</td>
<td>HRG 2005 - TCMTESTS (da06)</td>
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<tr>
<td>Abdominal ultrasounds</td>
<td>37</td>
<td>HRG 2005 - TRADIO (rbb3)</td>
</tr>
<tr>
<td>24-hour tapes</td>
<td>68</td>
<td>HRG 2005 - TCMTESTS (da0124)</td>
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<tr>
<td>Percutaneous intervention</td>
<td>2,988</td>
<td>HRG 2005 - TELIP, percutaneous coronary intervention (E15)</td>
</tr>
<tr>
<td>Coronary artery bypass graft</td>
<td>7,845</td>
<td>HRG 2005 - TELIP - coronary bypass (E04)</td>
</tr>
</tbody>
</table>


2.4.3 Long-term costs and QALYs

We estimated the lifetime discounted QALYs accrued by survivors with myocardial infarction or ACS and the associated long-term costs of care for these patients using data from a cost-effectiveness analysis of primary angioplasty compared to thrombolytic therapy for acute myocardial infarction (Vergel et al., 2006). This analysis used a Markov model to reflect the major clinical and resource-generating events that a patient may experience through the course of their remaining life. The model was principally populated with data from a total
The ESCAPE trial of chest pain units

of 627 patients with 5 years of follow-up from the Nottingham Heart Attack Register. The estimates of discounted long-term mean cost and QALYs following standard therapy (thrombolytics) from the model were £10,080 and 6.83 respectively. These values concur with estimates we used for patients surviving myocardial infarction and ACS in our previous cost-effectiveness analysis of diagnostic strategies for acute chest pain (Goodacre and Calvert, 2003).

2.4.4 Modelling of cost-effectiveness

Costs and outcomes were modelled using the decision tree outlined in Figure 1 to estimate the incremental cost per QALY gained. The parameters used in the tree are defined and their data sources outlined in Tables 2–4. We felt that it was appropriate to use probabilistic sensitivity analysis for modelling the cost-effectiveness because (a) we needed to use the findings from multiple data sources and (b) we wanted to quantify the uncertainty in the findings by placing a probability distribution around parameter values.

Beta distributions were fitted to the parameters pSTEMI, pACSdisc and incmort whereas normal distributions were fitted to all of the remaining parameters. Having chosen the parameters for the distributions in the model, values were selected at random from each distribution and costs and outcomes associated with each possible pathway were calculated. This process was repeated 1000 times and thus we were able to calculate a confidence interval around relevant parameters.

<table>
<thead>
<tr>
<th>Table 2 Probability parameters</th>
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</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>pSTEMI</td>
</tr>
<tr>
<td>MortSTEMI</td>
</tr>
<tr>
<td>CpuSTEMI</td>
</tr>
<tr>
<td>pACSdisc</td>
</tr>
<tr>
<td>CPUdisc</td>
</tr>
<tr>
<td>Incmort</td>
</tr>
</tbody>
</table>
### The ESCAPE trial of chest pain units

#### Table 3  Outcome parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>RoutQALY</td>
<td>QALYs accrued up to 6 months after initial attendance at a hospital with no CPU</td>
<td>Trial data: area under the curve for health utility for all patients attending a hospital with no active CPU</td>
</tr>
<tr>
<td>CpuQALY</td>
<td>Effect of CPU availability upon QALYs accrued up to 6 months after initial attendance</td>
<td>Trial data: effect of CPU availability upon area under the curve for health utility</td>
</tr>
<tr>
<td>ltQALY</td>
<td>Lifetime QALYs accrued by a typical patient with CHD</td>
<td>External data: Vergel et al. (2006)</td>
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</table>

#### Table 4  Cost parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>RoutCOST</td>
<td>Costs up to 6 months after initial attendance at a hospital with no CPU</td>
<td>Trial data: mean cost per patient for all attending a hospital with no CPU</td>
</tr>
<tr>
<td>CpuCOST</td>
<td>Effect of CPU availability upon costs up to 6 months after initial attendance</td>
<td>Trial data: effect of CPU availability upon mean cost per patient</td>
</tr>
<tr>
<td>ltCOST</td>
<td>Lifetime costs of care for a typical patient with CHD</td>
<td>External data: Vergel et al. (2006)</td>
</tr>
</tbody>
</table>
Section 3  Recruitment, allocation and service development

We contacted 80 hospitals that expressed an interest in participating in the trial. Ultimately, 11 decided to set up a CPU and didn’t want to risk being randomised to non-intervention, 17 felt they would not be able to provide CPU care if randomised to do so, two raised concerns about the research aspects of the trial, 36 gave either other reasons or no specific reason for declining to participate and 14 agreed to participate. Contact with interested but non-participating hospitals suggested that the main barriers to participation related to insufficient organisational flexibility to allow random allocation of service development and inability to provide initial CPU set-up costs, despite the prospect of reimbursement.

The participating hospitals were (in alphabetical order): City Hospital (Birmingham), Dewsbury District Hospital, Hairmyres Hospital, Halton General Hospital, Peterborough District Hospital, Queens Medical Centre (Nottingham), Scunthorpe General Hospital, Taunton and Somerset Hospital, University Hospital Aintree, Warrington Hospital, West Cumberland Infirmary (Whitehaven), Whiston Hospital, Wythenshawe Hospital and Worcestershire Royal Hospital.

The hospitals were allocated identifying letters A–N in the order that they were recruited and were randomised in pairs, one to set up a CPU and one to continue with routine care (controls). The characteristics of the hospitals are shown in Tables 5 (CPU hospitals) and 6 (control hospitals). The participating hospitals reflected a wide variety of acute NHS hospital characteristics, ranging from one of the smallest acute hospitals in the country to one of the largest. The CPU hospitals tended to be smaller, more rural and less likely to be teaching hospitals than the control hospitals.

Table 5  Characteristics of hospitals randomised to set up CPU care

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Annual adult ED attendances</th>
<th>Number of acute beds</th>
<th>Teaching hospital?</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>41,734</td>
<td>409</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>D</td>
<td>77,121</td>
<td>462</td>
<td>Yes</td>
<td>Urban</td>
</tr>
<tr>
<td>E</td>
<td>73,862</td>
<td>712</td>
<td>No</td>
<td>Urban</td>
</tr>
<tr>
<td>G</td>
<td>37,189</td>
<td>750</td>
<td>No</td>
<td>County town</td>
</tr>
<tr>
<td>J</td>
<td>54,449</td>
<td>512</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>L</td>
<td>20,884</td>
<td>330</td>
<td>No</td>
<td>Rural</td>
</tr>
<tr>
<td>N</td>
<td>43,875</td>
<td>607</td>
<td>No</td>
<td>County town</td>
</tr>
</tbody>
</table>

ED, emergency department.
The ESCAPE trial of chest pain units

Table 6  Characteristics of hospitals randomised to control

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Annual adult ED attendances</th>
<th>Number of acute beds</th>
<th>Teaching hospital?</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>42,102</td>
<td>895</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>C</td>
<td>53,516</td>
<td>Not available</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>F</td>
<td>94,470</td>
<td>Not available</td>
<td>Yes</td>
<td>Urban</td>
</tr>
<tr>
<td>H</td>
<td>55,786</td>
<td>871</td>
<td>Yes</td>
<td>Urban</td>
</tr>
<tr>
<td>I</td>
<td>38,898</td>
<td>419</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>K</td>
<td>23,550</td>
<td>180</td>
<td>No</td>
<td>Industrial town</td>
</tr>
<tr>
<td>M</td>
<td>113,878</td>
<td>520</td>
<td>Yes</td>
<td>Urban</td>
</tr>
</tbody>
</table>

ED, emergency department.

3.1 Service development at the CPU hospitals

All seven hospitals randomised to the CPU group successfully set up a CPU that remained operational for the whole year of the trial. The CPUs varied in location, staffing and operational hours, as outlined in Table 7.

Table 7  Characteristics of the CPUs

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Staffing</th>
<th>Opening hours</th>
<th>Location</th>
<th>Blood tests</th>
<th>Exercise test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 chest pain nurses</td>
<td>5 days/week, 07.30–19.30</td>
<td>Emergency department</td>
<td>Laboratory</td>
<td>Cardiology department</td>
</tr>
<tr>
<td>D</td>
<td>6 chest pain nurses</td>
<td>7 days/week, 24 hours</td>
<td>Heart Assessment Centre</td>
<td>Laboratory</td>
<td>Cardiology department</td>
</tr>
<tr>
<td>E</td>
<td>1 chest pain nurse</td>
<td>5 days/week, 09.00–17.00</td>
<td>Emergency department</td>
<td>Laboratory</td>
<td>Cardiology department</td>
</tr>
<tr>
<td>G</td>
<td>2 chest pain nurses (1 wte)</td>
<td>5 days/week, 08.00–16.00</td>
<td>Emergency department</td>
<td>Laboratory</td>
<td>Emergency department</td>
</tr>
<tr>
<td>J</td>
<td>1 emergency department nurse</td>
<td>5 days/week, 09.00–17.00</td>
<td>Emergency department</td>
<td>Laboratory</td>
<td>Cardiology department</td>
</tr>
<tr>
<td>L</td>
<td>Overseen by physicians</td>
<td>Ad hoc</td>
<td>Emergency department</td>
<td>Point of care</td>
<td>Cardiology department</td>
</tr>
<tr>
<td>N</td>
<td>1 chest pain nurse</td>
<td>5 days/week, 08.00–16.00</td>
<td>Medical Assessment Unit</td>
<td>Laboratory</td>
<td>Cardiology department</td>
</tr>
</tbody>
</table>

wte, whole-time equivalent.
The ESCAPE trial of chest pain units

In five out of the seven hospitals, the units were based in or adjacent to the emergency department and run by emergency department staff. The other two sites were located away from the emergency department, but suitable patients were identified within the emergency department before moving to a different location. Staffing of the units varied, with five of the seven units using specialist chest pain nurses, while two other units used staff they had currently in post. Operational hours varied, mainly due to the staffing levels. Six units used the hospital laboratories for blood testing. In one hospital, point-of-care testing was used because the laboratories were unable to ensure a 1-hour turnaround time. Only one hospital was able to provide exercise treadmill testing by chest pain nurses in the emergency department. The other six provided treadmill testing in the cardiology department on the next working day.

3.2 CPU activity

A total of 1644 patients were managed according to the CPU protocol, had their details recorded by CPU staff and attracted remuneration for the hospital. The proportion of adult attendances managed on the CPU varied from 1 to 7 per 1000 attendances. Table 8 shows what happened to these patients. Overall, 1374 (83%) were discharged after assessment. The proportion of patients discharged did not vary substantially between hospitals, ranging from 79 to 89%, while the proportion suffering adverse events after discharge varied from 0 to 3%. Overall, there were 23 adverse events among the discharged patients (1.7%) over the 30 days following discharge: one cardiac death, one non-cardiac death, three non-fatal myocardial infarctions and 18 chest pain-related re-admissions of more than 48 hours.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Adult ED attendances in the trial year</th>
<th>CPU patients (% of adult ED attendances)</th>
<th>Number (%) of CPU patients discharged</th>
<th>Number (%) of adverse events among discharged</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>43,897</td>
<td>91 (0.2)</td>
<td>81 (89)</td>
<td>2 (2.5)</td>
</tr>
<tr>
<td>D</td>
<td>83,402</td>
<td>484 (0.6)</td>
<td>381 (79)</td>
<td>4 (1.0)</td>
</tr>
<tr>
<td>E</td>
<td>75,558</td>
<td>537 (0.7)</td>
<td>466 (87)</td>
<td>14 (3.0)</td>
</tr>
<tr>
<td>G</td>
<td>38,708</td>
<td>201 (0.5)</td>
<td>161 (80)</td>
<td>3 (1.9)</td>
</tr>
<tr>
<td>J</td>
<td>58,101</td>
<td>78 (0.1)</td>
<td>67 (86)</td>
<td>0</td>
</tr>
<tr>
<td>L</td>
<td>22,196</td>
<td>65 (0.3)</td>
<td>58 (89)</td>
<td>0</td>
</tr>
<tr>
<td>N</td>
<td>46,471</td>
<td>188 (0.4)</td>
<td>160 (85)</td>
<td>0</td>
</tr>
</tbody>
</table>

ED, emergency department.

Table 9 shows the characteristics of patients managed on each CPU. These suggest that two of the CPUs that managed fewer patients (hospitals A and J) selected younger patients with fewer risk factors and fewer with known CHD. Conversely, two of the CPUs that managed more patients (hospitals E and G) included older patients and more with risk factors or known CHD.
## The ESCAPE trial of chest pain units

### Table 9 Characteristics of patients managed on each CPU

<table>
<thead>
<tr>
<th>Hospital...</th>
<th>A</th>
<th>D</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>L</th>
<th>N</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years; 95% CI)</td>
<td>47 (44–49)</td>
<td>51 (50–52)</td>
<td>55 (54–56)</td>
<td>58 (56–60)</td>
<td>45 (42–47)</td>
<td>51 (48–55)</td>
<td>53 (51–55)</td>
<td>53 (52–54)</td>
</tr>
<tr>
<td>% Male (95% CI)</td>
<td>47/91, 52% (42–62)</td>
<td>266/48, 55% (50–59)</td>
<td>299/53, 56% (52–60)</td>
<td>115/20, 57% (50–64)</td>
<td>46/78, 59% (48–69)</td>
<td>40/65, 62% (49–72)</td>
<td>120/18, 64% (57–70)</td>
<td>933/1,64, 57% (54–59)</td>
</tr>
<tr>
<td>% Known CHD (95% CI)</td>
<td>2/87, 2% (0–8)</td>
<td>24/461, 5% (3–8)</td>
<td>131/53, 4% (21–29)</td>
<td>35/194, 18% (13–24)</td>
<td>0/72, 0% (0–5)</td>
<td>0/62, 0% (0–6)</td>
<td>15/183, 8% (5–13)</td>
<td>207/1,59, 13% (11–15)</td>
</tr>
<tr>
<td>Diabetes (95% CI)</td>
<td>5/90, 6% (2–12)</td>
<td>17/468, 4% (2–6)</td>
<td>56/522, 11% (8–14)</td>
<td>11/192, 6% (3–10)</td>
<td>1/67, 1% (0–8)</td>
<td>4/63, 6% (2–15)</td>
<td>8/179, 4% (2–9)</td>
<td>102/1,58, 6% (5–8)</td>
</tr>
<tr>
<td>Hypertension (95% CI)</td>
<td>11/86, 13% (7–22)</td>
<td>129/46, 1, 28% (24–32)</td>
<td>191/52, 1, 37% (33–41)</td>
<td>70/192, 36% (30–43)</td>
<td>9/69, 13% (7–23)</td>
<td>14/62, 23% (14–34)</td>
<td>55/177, 31% (25–38)</td>
<td>479/1,56, 8, 31% (28–34)</td>
</tr>
<tr>
<td>Hyperlipidaemia (95% CI)</td>
<td>12/84, 14% (8–23)</td>
<td>101/44, 9, 23% (19–27)</td>
<td>165/52, 2, 32% (28–36)</td>
<td>78/201, 39% (32–46)</td>
<td>6/62, 10% (5–20)</td>
<td>6/61, 10% (5–20)</td>
<td>43/169, 25% (19–33)</td>
<td>415/1,47, 2, 28% (26–31)</td>
</tr>
<tr>
<td>Family history of CHD (95% CI)</td>
<td>25/68, 37% (26–49)</td>
<td>197/42, 6, 46% (42–51)</td>
<td>269/51, 3, 52% (48–57)</td>
<td>73/174, 42% (35–49)</td>
<td>24/64, 38% (27–50)</td>
<td>24/54, 44% (32–58)</td>
<td>56/174, 32% (26–39)</td>
<td>668/1,47, 4, 45% (43–48)</td>
</tr>
</tbody>
</table>

95% CI, 95% confidence interval.

Figure 2 shows the monthly number of patients managed by each CPU. There was no obvious consistent trend, such as a lag phase in development or tailing across after initial enthusiasm, across all sites. Activity may have built up over the year at hospitals E and G, and may have tailed off in hospitals D and J.
Tables 10 and 11 show the blood tests and exercise treadmill tests recorded at each hospital, respectively. Most patients received two blood samples; however, a proportion that presented late received a single troponin sample. The exception was hospital N were most patients simply received a single troponin sample. Most units performed exercise treadmill testing in around 66% of patients, as in the previous study (Goodacre et al., 2004a). The exception was hospital E, where only 46% received treadmill testing, perhaps reflecting the higher proportion of older patients and those with known CHD managed by this unit.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Total number of patients seen</th>
<th>Number receiving first CK-MB only</th>
<th>Number receiving second sample (CK-MB and troponin)</th>
<th>Number receiving troponin only</th>
<th>Data not recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>91</td>
<td>5 (5%)</td>
<td>69 (76%)</td>
<td>15 (16%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>D</td>
<td>484</td>
<td>1 (&lt;1%)</td>
<td>461 (95%)</td>
<td>12 (2%)</td>
<td>10 (2%)</td>
</tr>
<tr>
<td>E</td>
<td>537</td>
<td>5 (&lt;1%)</td>
<td>401 (75%)</td>
<td>122 (23%)</td>
<td>9 (2%)</td>
</tr>
<tr>
<td>G</td>
<td>201</td>
<td>6 (3%)</td>
<td>163 (81%)</td>
<td>28 (14%)</td>
<td>4 (2%)</td>
</tr>
<tr>
<td>J</td>
<td>78</td>
<td>0</td>
<td>54 (69%)</td>
<td>11 (14%)</td>
<td>13 (17%)</td>
</tr>
<tr>
<td>L</td>
<td>65</td>
<td>0</td>
<td>64 (98%)</td>
<td>0</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>N</td>
<td>188</td>
<td>1 (&lt;1%)</td>
<td>24 (13%)</td>
<td>151 (80%)</td>
<td>12 (6%)</td>
</tr>
</tbody>
</table>

*CK-MB, creatine kinase MB.*
The ESCAPE trial of chest pain units

Table 11 Exercise treadmill tests (ETTs) carried out on patients managed on the CPUs

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Total number of patients seen</th>
<th>Number of ETTs carried out</th>
<th>Not suitable for ETT, or not carried out for other reason</th>
<th>Data not recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>91</td>
<td>75 (82%)</td>
<td>15 (16%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>D</td>
<td>484</td>
<td>320 (66%)</td>
<td>145 (30%)</td>
<td>19 (4%)</td>
</tr>
<tr>
<td>E</td>
<td>537</td>
<td>246 (46%)</td>
<td>274 (51%)</td>
<td>17 (3%)</td>
</tr>
<tr>
<td>G</td>
<td>201</td>
<td>127 (63%)</td>
<td>63 (31%)</td>
<td>11 (5%)</td>
</tr>
<tr>
<td>J</td>
<td>78</td>
<td>61 (78%)</td>
<td>7 (9%)</td>
<td>10 (13%)</td>
</tr>
<tr>
<td>L</td>
<td>65</td>
<td>52 (80%)</td>
<td>7 (11%)</td>
<td>6 (9%)</td>
</tr>
<tr>
<td>N</td>
<td>188</td>
<td>147 (78%)</td>
<td>39 (21%)</td>
<td>2 (1%)</td>
</tr>
</tbody>
</table>

3.3 Service development at the control sites

Table 12 outlines the chest pain services that were provided at the control sites. Four of the hospitals had specialist chest pain nurses providing care in the emergency department, mainly for patients with ACS and those requiring thrombolysis. All used a troponin assay as the cardiac marker. This was available 24 hours a day at three hospitals and 09.00–17.00 only at four, although two of these provided point-of-care cardiac markers 24 hours a day on the coronary care unit. The cardiac marker protocol at all six hospitals that used a protocol was for single 12-hour troponin. This timing, alongside the limited availability of troponin assays, suggests that most patients requiring assessment for ACS at the control hospitals would have been admitted to hospital.

All the hospitals provided exercise treadmill testing in the cardiology department. The waiting time was typically between 1 and 3 weeks, although two hospitals were able to provide testing within a few days. The only change reported over the trial year was the development of nurse-led treadmill testing in the rapid-access chest pain clinic of one hospital.
<table>
<thead>
<tr>
<th>Hospital</th>
<th>Chest pain nurses</th>
<th>Cardiac marker availability</th>
<th>Cardiac marker protocol</th>
<th>ETT (waiting time)</th>
<th>Changes in trial year</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>3</td>
<td>Troponin Point of Care on CCU 24 hours Labs 09.00-17.00</td>
<td>12-hour Troponin</td>
<td>Cardiology department (2-3 weeks)</td>
<td>None</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>Troponin Point of care on CCU 24 hours Labs 09.00-17.00</td>
<td>12-hour Troponin</td>
<td>Cardiology department (up to 2 weeks)</td>
<td>None</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>Troponin Labs 24 hours</td>
<td>12-hour Troponin</td>
<td>Cardiology department (1-3 days)</td>
<td>Nurse-led ETT within a rapid-access chest pain clinic</td>
</tr>
<tr>
<td>H</td>
<td>0</td>
<td>Troponin Labs 24 hours</td>
<td>No protocol</td>
<td>Cardiology department (2 weeks)</td>
<td>None</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
<td>Troponin Labs 09.00-17.00</td>
<td>12-hour Troponin</td>
<td>Cardiology department (1-2 days)</td>
<td>None</td>
</tr>
<tr>
<td>K</td>
<td>1</td>
<td>Troponin Labs 09.00-16.00</td>
<td>12-hour Troponin</td>
<td>Cardiology department (2 weeks)</td>
<td>None</td>
</tr>
<tr>
<td>M</td>
<td>1</td>
<td>Troponin Labs 24 hour</td>
<td>12-hour Troponin</td>
<td>Cardiology department (1 week)</td>
<td>None</td>
</tr>
</tbody>
</table>

CCU, coronary care unit; ETT, exercise treadmill test.

### 3.4 Discussion

We were only able to recruit 14 participating hospitals instead of the intended 18, despite contacting most hospitals in the UK and pursuing recruitment at 80 that expressed an interest. The main barriers to recruitment appeared to be lack of organisational flexibility to allow random allocation of service development and inability to provide initial CPU set-up costs, despite the prospect of reimbursement. This raises the possibility that participating hospitals may not be typical of the NHS. The participating hospitals included a variety of different sizes, locations and teaching and non-teaching hospitals, so if they were unrepresentative it appears that this did not manifest itself in overt characteristics. Most of the non-participating hospitals would have been able to support a CPU, but were unable to agree to randomisation or meet study
The ESCAPE trial of chest pain units

deadlines. So it is possible that the participating hospitals could have been unrepresentative in a more subtle way, such as having an unusual degree of organisational flexibility or atypical willingness to support research.

All the hospitals randomised to set up a CPU did so successfully and continued to operate throughout the trial year. The proportion of patients discharged home after assessment was similar across all seven units (79–89%) and similar to previous studies of CPU care (Goodacre, 2002; Herren et al., 2001; Taylor et al. 2002). Adverse events were uncommon among patients discharged after CPU assessment. These findings suggest that the CPUs were safe (in terms of few adverse events) and practical (in terms of most patients being discharged after assessment), and add to a substantial supporting body of data (Goodacre, 2000).

There was substantial variation between hospitals in the number of patients recorded as being managed by the CPU protocol. Some but not all of this was explained by differences in the number of new patient emergency department attendances. The number of CPU patients per 1000 adult attendances varied from one to seven. There was a trend towards larger hospitals having more CPU patients per 1000 adult attendances, but some inconsistencies were evident. Some of the variation may reflect differences in patient selection, particularly the inclusion of older patients and those with known CHD. Variation in CPU activity was not apparently related to CPU location, staffing or opening hours.

Three previous studies have reported the performance of CPUs or rapid rule-out protocols in the UK. Herren et al. (2001) reported managing 383 patients over 1 year at the Manchester Royal Infirmary, the Sheffield CPU managed 534 patients over the first year of operation (Goodacre et al., 2002), and Taylor et al. (2002) reported managing 100 patients over 6 months at the Royal United Hospital in Bath. Four of the ESCAPE hospitals (D, E, G and N) managed similar numbers during their first year of operation, while three (A, J and L) managed markedly fewer. Previous reports may be subject to a degree of selection and publication bias because their activity may be driven by the enthusiasts keen to acquire publishable data and hospitals may have been more likely to submit their data for publication if activity levels were relatively high. The current study may therefore provide a more accurate reflection of CPU activity in more typical NHS hospitals.

These data do not show the full range of potential CPU activity. CPU staff only recorded details for patients who were managed according to the CPU protocol and attracted reimbursement. Other patients, such as those with unstable angina or myocardial infarction, that were managed by CPU staff or using CPU facilities, would not have been recorded. It is also possible that availability of the CPU may have influenced the management of other, non-CPU patients. For example, employment of additional chest pain nurses, access to short-stay beds or changes in access to blood or exercise tests may have resulted in unrecorded changes to the care of other patients. It is also possible that, despite our efforts, hospital staff treated the CPU as an experimental intervention and did not use the CPU in the same way that they would in normal practice.

One specific limitation relates to the recording of adverse events. We relied upon routine data sources and patient re-attendance at the hospital to identify
The ESCAPE trial of chest pain units

adverse events. It is possible that patients may have presented elsewhere or not attended hospital at all with adverse events, leading to an underestimate of adverse events. This is an inevitable consequence of minimising research interference with patient care. However, previous studies of CPU care with more rigorous follow up (Goodacre et al., 2002) have shown low rates of adverse events.

The control hospitals did not explicitly develop the key elements of CPU care and showed clear differences from CPU hospitals. Cardiac marker protocols and availability restrictions meant that control hospitals did not provide rapid rule-out of myocardial infarction, while access to exercise treadmill testing was not immediate or, in most cases, on the next working day. However, there were some similarities to CPU care. Some control hospitals employed chest pain nurses and recent development of cardiology services meant that delays to treadmill testing were not severe. These developments have the potential to ‘dilute’ the effect of introducing CPU care.

3.5 Summary

- Participating hospitals showed a variety of characteristics reflecting the range of hospitals operating in the NHS, although their willingness to participate may suggest that they are more flexible or supportive of research than most hospitals.
- All hospitals allocated to set up a CPU were able to do so in a safe and practical manner.
- CPU activity varied substantially between hospitals and could not be explained in terms of hospital size or basic CPU characteristics.
- Service development at CPU and control hospitals was sufficiently distinct to allow meaningful comparisons, but development of chest pain nurses and improved access to exercise testing at control hospitals may ‘dilute’ the potential impact of CPU development in the trial.
4.1 Routine emergency department attendance data

All hospitals provided routine emergency department attendance data for the pre-intervention and post-intervention years. We were able to identify chest pain-related attendances for the whole time period at all but one hospital (B). This hospital had changed their computer system and their means of recording presenting complaint 2 months into the pre-intervention year. We therefore excluded the first 2 months of each year and only used data from 10 months before and after intervention at this hospital.

A total of 37,319 patients with chest pain attended the emergency departments of the study hospitals in the pre-intervention year, 17,789 at the seven CPU hospitals and 19,530 at the control hospitals. Mean age was 54.3 years (range 16–105 years), 19,850 (53.1%) were male, 15,449 (41.4%) were female and gender was unknown for 2065 (5.5%). Most patients (33,325, 89.3%) attended only once during the year, but 2924 (7.8%) attended twice, 624 (1.7%) attended three times, 203 (0.5%) attended four times and 243 (0.7%) attended more than four times. Overall the 37,319 patients made a total of 43,642 attendances. Patients attending CPU hospitals were older (mean age 56.1 compared with 52.7 years). Excluding patients with unknown gender, the proportions of males at CPU and control hospitals were similar (55.9 compared with 56.4%).

A total of 40,951 patients with chest pain attended the emergency departments of the study hospitals in the post-intervention year, 20,546 at the seven CPU hospitals and 20,405 at the control hospitals. Mean age was 54.0 years (range 16–104 years), 21,851 (53.4%) were male, 17,071 (41.7%) were female and gender was unknown for 2029 (5.0%). Most patients (36,589, 89.3%) attended only once during the year, but 3184 (7.8%) attended twice, 704 (1.7%) attended three times, 219 (0.5%) attended four times and 255 (0.7%) attended more than four times. Overall the 40,951 patients made a total of 47,767 attendances. Patients attending CPU hospitals were older (mean age 55.1 compared with 52.9 years). Excluding patients with unknown gender, the proportions of males at CPU and control hospitals were similar (55.6 compared with 56.6%).

The number of patients recorded as attending control hospitals in the post-intervention year increased by 4.5% compared to the pre-intervention year. There was a much larger (15.5%) increase recorded at the CPU hospitals. In the post-intervention year patients attending a CPU hospital tended to be older (difference=0.9 years, 95% CI, 0.4–1.5 years; \( p=0.001, \rho=0.0216 \)) but had a similar proportion of males (odds ratio=0.98, 95% CI, 0.92–1.04; \( p=0.504, \rho<0.001 \)) to those attending a control hospital, after adjustment for pre-intervention differences between CPU and control hospitals. So the recorded
The ESCAPE trial of chest pain units

increase in patients attending CPU hospitals post-intervention was associated with a decrease in mean patient age.

4.2 Total emergency department attendances

Table 13 shows the total number of adult emergency department attendances (all complaints) over the pre-intervention and post-intervention years of the study. Attendances increased at all but two of the hospitals (C and K). There were a total of 422,200 attendances pre-intervention and 432,319 post-intervention at the control hospitals, an increase of 2.4%. At the CPU hospitals there were 349,113 attendances pre-intervention and 369,363 post-intervention, an increase of 5.8%.

Table 13 Total adult emergency department attendances

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Allocation</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>CPU</td>
<td>41,734</td>
<td>43,897</td>
<td>5.2</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>77,121</td>
<td>83,402</td>
<td>8.1</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>73,861</td>
<td>75,588</td>
<td>2.3</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>37,189</td>
<td>39,708</td>
<td>6.8</td>
</tr>
<tr>
<td>J</td>
<td></td>
<td>54,449</td>
<td>58,101</td>
<td>6.7</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>20,884</td>
<td>22,196</td>
<td>6.3</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>43,875</td>
<td>46,471</td>
<td>5.9</td>
</tr>
<tr>
<td>B</td>
<td>Control</td>
<td>42,102</td>
<td>45,152</td>
<td>7.2</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>53,516</td>
<td>52,224</td>
<td>-2.4</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>94,470</td>
<td>94,985</td>
<td>0.5</td>
</tr>
<tr>
<td>H</td>
<td></td>
<td>55,786</td>
<td>59,232</td>
<td>6.2</td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>38,898</td>
<td>41,769</td>
<td>7.4</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td>23,550</td>
<td>21,692</td>
<td>-7.9</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>113,878</td>
<td>117,265</td>
<td>3.0</td>
</tr>
</tbody>
</table>

4.3 Emergency department attendances with chest pain

Table 14 shows the number of emergency department attendances with chest pain or a similar presenting complaint over the pre-intervention and post-intervention years of the study. Attendances increased at all but three of the hospitals (L, K and M). There were a total of 22,858 attendances pre-intervention and 23,666 post-intervention at the control hospitals, an increase of 3.5%. At the CPU hospitals there were 20,784 attendances pre-intervention and 24,101 post-intervention, an increase of 16.0%.
### Table 14 Total adult emergency department attendances with chest pain

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Allocation</th>
<th>N (% of total attendances)</th>
<th>% Increase in chest pain attendances</th>
<th>Change in the % of attendances with chest pain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-intervention</td>
<td>Post-intervention</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>CPU</td>
<td>2409 (5.7%)</td>
<td>2410 (5.5%)</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>4815 (6.2%)</td>
<td>6423 (7.7%)</td>
<td>33.4</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>5134 (7.0%)</td>
<td>5803 (7.7%)</td>
<td>13.0</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>1907 (5.1%)</td>
<td>2312 (5.8%)</td>
<td>21.2</td>
</tr>
<tr>
<td>J</td>
<td></td>
<td>2511 (4.6%)</td>
<td>2992 (5.1%)</td>
<td>19.2</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>1492 (7.1%)</td>
<td>1460 (6.6%)</td>
<td>-2.1</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>2516 (5.7%)</td>
<td>2701 (5.8%)</td>
<td>7.4</td>
</tr>
<tr>
<td>B</td>
<td>Control</td>
<td>1643 (5.5%)</td>
<td>2005 (5.3%)</td>
<td>22.0</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>2237 (4.2%)</td>
<td>2334 (4.5%)</td>
<td>4.3</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>4638 (4.9%)</td>
<td>4644 (4.9%)</td>
<td>0.1</td>
</tr>
<tr>
<td>H</td>
<td></td>
<td>5095 (9.1%)</td>
<td>5368 (9.1%)</td>
<td>5.4</td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>1918 (4.9%)</td>
<td>2209 (5.3%)</td>
<td>15.2</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td>1596 (6.8%)</td>
<td>1386 (6.4%)</td>
<td>-13.2</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>5731 (5.0%)</td>
<td>5720 (4.9%)</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

The change in the percentage of emergency department attendances presenting with chest pain is shown for each hospital in Figure 3. CPU hospitals are shown as red columns and control hospitals as blue columns. Although the proportion of attendances with chest pain was more likely to have increased at CPU hospitals there was some inconsistency and one of the CPU hospitals showed a more marked change than any other hospital (D). We used a nested analysis of variance in the logits of the proportions to test the hypothesis that the change in the proportion of attendances with chest pain differed between CPU and control hospitals. This showed that there was some weak evidence ($p=0.08$) that the proportion of attendances with chest pain had increased at CPU hospitals more than control hospitals.
**The ESCAPE trial of chest pain units**

Figure 3  Percentage change in chest pain attendances at each hospital

![Percentage change in chest pain attendances at each hospital](image)

_CPU hospitals are shown as red columns and control hospitals as blue columns._

Table 15 shows the outcome of the chest pain attendances at each hospital in the pre- and post-intervention years. The proportion of patients admitted at the control hospitals increased from 52.2% (11,664/22,358) to 52.6% (12,255/23,278), whereas the proportion of patients admitted at the CPU hospitals decreased from 65.4% (13,304/20,356) to 64.4% (15,199/23,592).
# The ESCAPE trial of chest pain units

## Table 15  Outcome of chest pain attendances

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Admitted (%)</td>
<td>Discharged (%)</td>
</tr>
<tr>
<td>A</td>
<td>1494 (62.0%)</td>
<td>903 (37.5%)</td>
</tr>
<tr>
<td>D</td>
<td>3075 (63.9%)</td>
<td>1740 (36.1%)</td>
</tr>
<tr>
<td>E</td>
<td>3115 (60.7%)</td>
<td>1800 (35.1%)</td>
</tr>
<tr>
<td>G</td>
<td>1290 (67.6%)</td>
<td>601 (31.5%)</td>
</tr>
<tr>
<td>J</td>
<td>1677 (66.8%)</td>
<td>782 (31.1%)</td>
</tr>
<tr>
<td>L</td>
<td>1243 (83.3%)</td>
<td>248 (16.6%)</td>
</tr>
<tr>
<td>N</td>
<td>1407 (55.9%)</td>
<td>983 (39.1%)</td>
</tr>
<tr>
<td>B</td>
<td>906 (55.1%)</td>
<td>664 (40.4%)</td>
</tr>
<tr>
<td>C</td>
<td>1058 (47.3%)</td>
<td>1171 (52.3%)</td>
</tr>
<tr>
<td>F</td>
<td>2543 (54.8%)</td>
<td>2036 (43.9%)</td>
</tr>
<tr>
<td>H</td>
<td>2537 (49.8%)</td>
<td>2223 (43.6%)</td>
</tr>
<tr>
<td>I</td>
<td>1489 (77.6%)</td>
<td>423 (22.1%)</td>
</tr>
<tr>
<td>K</td>
<td>1106 (69.3%)</td>
<td>490 (30.7%)</td>
</tr>
<tr>
<td>M</td>
<td>2025 (35.3%)</td>
<td>3687 (64.3%)</td>
</tr>
</tbody>
</table>

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Figure 4 shows the change in the percentage admitted at each hospital. There is a trend towards a decreased percentage admitted at CPU hospitals and a trend towards an increased percentage admitted at control hospitals, although these are not consistent.

**Figure 4 Change in the proportion of patients with chest pain admitted at each hospital**

CPU hospitals are shown as red columns and control hospitals as blue columns.

The odds ratio for the effect of CPU availability upon admission, compared with control hospitals and adjusted for pre-intervention admission rates, is 0.942 (95% CI, 0.892–0.994, p=0.029, rho<0.0001). However, this finding appears to be confounded by age. If age and gender are included in the analysis the association is no longer significant; odds ratio=0.998 (95% CI, 0.940–1.059, p=0.945, rho<0.0001).

In summary, the introduction of CPU care may have been associated with an increase in the proportion of emergency department attendances with chest pain, but did not appear to reduce the proportion of patients with chest pain being admitted.

### 4.4 Emergency department re-attendances and (re-)admissions

Table 16 shows the number of patients attending the emergency department in the pre- or post-intervention year, the mean number of attendances per patient, the proportion of patients re-attending the emergency department within 30 days of their initial attendance and the proportion of patients (re-)admitted.
Table 16 Re-attendances and (re-)admissions within 30 days

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th></th>
<th>Post-intervention</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean attends per patient</td>
<td>Re-attends</td>
<td>Re-admits</td>
</tr>
<tr>
<td>A</td>
<td>2026</td>
<td>1.19</td>
<td>205 (10.1%)</td>
<td>105 (5.2%)</td>
</tr>
<tr>
<td>B</td>
<td>1421</td>
<td>1.16</td>
<td>133 (9.4%)</td>
<td>60 (4.2%)</td>
</tr>
<tr>
<td>C</td>
<td>1889</td>
<td>1.18</td>
<td>215 (11.4%)</td>
<td>88 (4.7%)</td>
</tr>
<tr>
<td>D</td>
<td>4097</td>
<td>1.18</td>
<td>468 (11.4%)</td>
<td>277 (6.8%)</td>
</tr>
<tr>
<td>E</td>
<td>4365</td>
<td>1.18</td>
<td>499 (11.4%)</td>
<td>283 (6.5%)</td>
</tr>
<tr>
<td>F</td>
<td>3872</td>
<td>1.20</td>
<td>426 (11.0%)</td>
<td>219 (5.7%)</td>
</tr>
<tr>
<td>G</td>
<td>1656</td>
<td>1.15</td>
<td>135 (8.2%)</td>
<td>72 (4.3%)</td>
</tr>
<tr>
<td>H</td>
<td>4335</td>
<td>1.18</td>
<td>420 (9.7%)</td>
<td>202 (4.7%)</td>
</tr>
<tr>
<td>I</td>
<td>1711</td>
<td>1.12</td>
<td>157 (9.2%)</td>
<td>103 (6.0%)</td>
</tr>
<tr>
<td>J</td>
<td>2216</td>
<td>1.13</td>
<td>218 (9.8%)</td>
<td>133 (6.0%)</td>
</tr>
<tr>
<td>K</td>
<td>1394</td>
<td>1.14</td>
<td>117 (8.4%)</td>
<td>84 (6.0%)</td>
</tr>
<tr>
<td>L</td>
<td>1206</td>
<td>1.24</td>
<td>103 (8.5%)</td>
<td>79 (6.6%)</td>
</tr>
<tr>
<td>M</td>
<td>4908</td>
<td>1.17</td>
<td>621 (12.7%)</td>
<td>194 (4.0%)</td>
</tr>
</tbody>
</table>

At the control hospitals, 10.7% of patients attending in the pre-intervention year (2089/19,526) re-attended within 30 days of their initial attendance and 4.9% were re-admitted (950/19,519), compared with 10.2% (2072/20,404) and 4.5% (910/20,392) respectively in the post-intervention year. At the CPU hospitals, 10.0% of those attending in the pre-intervention year (1786/17,789) re-attended within 30 days of their initial attendance and 5.7% were re-admitted.
The ESCAPE trial of chest pain units

(1015/17,783), compared with 10.4 (2132/20,546) and 6.2% (1272/20,539) respectively in the post-intervention year.

CPU care was associated with small increases in re-attendances (odds ratio, 1.10; 95% CI, 1.00–1.21; \( p=0.044, \rho<0.001 \)) and (re-)admissions (odds ratio, 1.28; 95% CI, 0.95–1.72; \( p=0.101, \rho=0.042 \)), compared to control hospitals and adjusted for pre-intervention differences. Inclusion of age and gender as covariates did not alter these findings (odds ratio for re-attendances, 1.10; 95% CI, 1.00–1.21; \( p=0.036, \rho<0.001 \); odds ratio for (re-)admissions, 1.30; 95% CI, 0.97–1.74; \( p=0.083, \rho=0.045 \)).

4.5 Emergency medical admissions

All the participating hospitals provided medical admissions data. One hospital (I) was only able to provide numbers of total daily medical admissions. All others were able to provide total daily medical admissions divided according to whether they were admitted via the emergency department or other routes. Another hospital (F) had a coding error that resulted in admissions details being miscoded for a substantial proportion of the trial. We were therefore only able to include data from 75 days before and 75 days after intervention at this site.

Across all hospitals the mean total daily number of admissions was 33.5 (range 3–149), mean daily admissions via the emergency department was 22.0 (range 0–109) and mean daily admissions via other routes was 12.5 (range 0–86). At CPU hospitals mean total admissions, emergency department admissions and other admissions were 36.1, 21.5 and 14.6 respectively in the pre-intervention year and 37.8, 23.7 and 14.1 in the post-intervention year. At control hospitals these values were 29.6, 20.6 and 10.5 respectively in the pre-intervention year and 29.7, 21.8 and 9.4 in the post-intervention year. The sum of emergency department and other values does not equal the total value for the control hospitals because of missing data from hospital I. Table 17 shows these data for the individual hospitals. CPU availability was associated with an increase in total admissions of 1.7 per day (95% CI, 0.8–2.5; \( p<0.001, \rho=0.769 \)), an increase in emergency department admissions of 1.0 per day (95% CI, 0.4–1.5; \( p=0.001, \rho=0.845 \)) and an increase in other admissions of 0.6 per day (95% CI, –0.1 to 1.3; \( p=0.078, \rho=0.564 \)), compared to control hospitals and adjusted for pre-intervention differences in admission rates.
Table 17 Mean daily emergency medical admissions

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Via the emergency department</td>
</tr>
<tr>
<td>A</td>
<td>38.5</td>
<td>16.2</td>
</tr>
<tr>
<td>D</td>
<td>44.9</td>
<td>3.5</td>
</tr>
<tr>
<td>E</td>
<td>45.4</td>
<td>11.4</td>
</tr>
<tr>
<td>G</td>
<td>48.4</td>
<td>36.6</td>
</tr>
<tr>
<td>J</td>
<td>24.1</td>
<td>5.8</td>
</tr>
<tr>
<td>L</td>
<td>19.7</td>
<td>10.4</td>
</tr>
<tr>
<td>N</td>
<td>31.6</td>
<td>17.9</td>
</tr>
<tr>
<td>B</td>
<td>30.8</td>
<td>19.0</td>
</tr>
<tr>
<td>C</td>
<td>22.4</td>
<td>5.3</td>
</tr>
<tr>
<td>F</td>
<td>85.3</td>
<td>28.3</td>
</tr>
<tr>
<td>H</td>
<td>35.4</td>
<td>6.3</td>
</tr>
<tr>
<td>I</td>
<td>21.8</td>
<td>NA</td>
</tr>
<tr>
<td>K</td>
<td>17.5</td>
<td>11.1</td>
</tr>
<tr>
<td>M</td>
<td>38.2</td>
<td>7.0</td>
</tr>
</tbody>
</table>

NA, not available.

Figure 5 shows the percentage change in the total mean daily number of medical admissions at each hospital. This shows that the CPU hospitals did not consistently increase their numbers of admissions more than the control hospitals. Indeed, two CPU hospitals had reduced emergency medical admissions during the post-intervention year. Therefore, if the introduction of CPU care is associated with increased admissions, this is not a consistent effect at all hospitals.
It is also apparent that the way that the analysis handles missing data at hospital F has an important effect upon the results. The basic analysis did not adjust for the reduced amount of data available from this hospital, so hospital F carries markedly less weight in the analysis than other hospitals. If we exclude hospital F from the analysis (effectively giving it zero weight) then CPU availability is associated with an increase in total admissions of 2.0 per day (95% CI, 1.3–2.8; \(p<0.001\), \(\rho=0.508\)), an increase in emergency department admissions of 1.4 per day (95% CI, 0.9–1.9; \(p<0.001\), \(\rho=0.754\)) and an increase in other admissions of 0.7 per day (95% CI, 0–1.4; \(p=0.067\), \(\rho=0.517\)). If, however, we weight data from hospital F by a factor of 2.43 in the analysis so that it carries equal weight to other hospitals then CPU availability is associated with an increase in total admissions of 0.4 per day (95% CI, −0.5 to 1.2), a decrease in emergency department admissions of 0.5 per day (95% CI, −0.1 to 1.1) and an increase in other admissions of 0.6 per day (95% CI, −0.2 to 1.3).

### 4.6 Change in outcome measures at individual CPU hospitals

Table 18 shows the changes in routine data outcomes for each of the CPU hospitals, alongside the estimate of CPU activity, expressed as the number of patients receiving the full CPU protocol per 1000 emergency department attendances. The hospitals are arranged in descending order of CPU activity. There is no consistent relationship between CPU activity and changes in outcomes, other than a slight trend towards hospitals with more active CPUs showing an increase in attendances with chest pain and a reduction in the proportion of these attendances being admitted.
The *ESCAPE* trial of chest pain units

Table 18  Outcomes for the CPU hospitals, according to CPU activity

<table>
<thead>
<tr>
<th>Hospital</th>
<th>CPU activity (cases per 1000 ED attends)</th>
<th>Change in % of chest pain attends</th>
<th>Change in % re-attending</th>
<th>Change in % (re-) admitted</th>
<th>Change in total daily medical admissions</th>
<th>Change in medical admissions via ED</th>
<th>Change in medical admissions via other routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>7fu</td>
<td>+0.7%</td>
<td>-4.0%</td>
<td>-0.8%</td>
<td>-6.6%</td>
<td>-10.3%</td>
<td>+3.5%</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>+1.5%</td>
<td>-1.2%</td>
<td>+0.2%</td>
<td>0%</td>
<td>+22.7%</td>
<td>+25.8%</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>+0.7%</td>
<td>-2.4%</td>
<td>+1.4%</td>
<td>+12.2%</td>
<td>+44.9%</td>
<td>+1.6%</td>
</tr>
<tr>
<td>N</td>
<td>4</td>
<td>+0.1%</td>
<td>+4.7%</td>
<td>+1.4%</td>
<td>+3.2%</td>
<td>+13.1%</td>
<td>-4.5%</td>
</tr>
<tr>
<td>L</td>
<td>3</td>
<td>-0.5%</td>
<td>-6.9%</td>
<td>+1.1%</td>
<td>-18.3%</td>
<td>-17.2%</td>
<td>-19.2%</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>-0.2%</td>
<td>-1.6%</td>
<td>+0.5%</td>
<td>+2.6%</td>
<td>+7.7%</td>
<td>-3.7%</td>
</tr>
<tr>
<td>J</td>
<td>1</td>
<td>+0.5%</td>
<td>+5.6%</td>
<td>+0.3%</td>
<td>+3.3%</td>
<td>+3.3%</td>
<td>+3.4%</td>
</tr>
</tbody>
</table>

*ED, emergency department.*
4.7 Emergency department waiting times

All participating hospitals provided waiting time data for the total time spent in the emergency department. Hospital D was unable to provide waiting time data for the time to see a treating clinician. Across all hospitals the median total department time was 100 minutes (interquartile range (IQR), 54–164) and the median time to see a treating clinician was 41 minutes (IQR, 18–80).

The median total departmental time was 104 minutes before intervention and 99 after intervention at the CPU hospitals compared with 100 and 99 minutes respectively at the control hospitals. The median time to see a treating clinician was 40 minutes before intervention and 43 after intervention at the CPU hospitals compared with 40 and 41 minutes respectively at the control hospitals. Tables 19 and 20 show median total departmental waiting time and median time to see a treating clinician at the individual hospitals.

The ratio of the median departmental waiting time at CPU hospitals to the median at control hospitals, adjusted for pre-intervention differences, was 0.91 (95% CI, 0.87–0.94, \( p < 0.001 \), rho=0.0851). The corresponding ratio for waiting time to see a treating clinician was 1.01 (95% CI, 0.96–1.07, \( p = 0.730 \), rho=0.0971).

Table 19  Median total departmental waiting time

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>84</td>
<td>92</td>
</tr>
<tr>
<td>D</td>
<td>157</td>
<td>132</td>
</tr>
<tr>
<td>E</td>
<td>149</td>
<td>142</td>
</tr>
<tr>
<td>G</td>
<td>86</td>
<td>80</td>
</tr>
<tr>
<td>J</td>
<td>106</td>
<td>100</td>
</tr>
<tr>
<td>L</td>
<td>64</td>
<td>55</td>
</tr>
<tr>
<td>N</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>B</td>
<td>97</td>
<td>91</td>
</tr>
<tr>
<td>C</td>
<td>101</td>
<td>92</td>
</tr>
<tr>
<td>F</td>
<td>119</td>
<td>117</td>
</tr>
<tr>
<td>H</td>
<td>128</td>
<td>140</td>
</tr>
<tr>
<td>I</td>
<td>127</td>
<td>105</td>
</tr>
<tr>
<td>K</td>
<td>51</td>
<td>73</td>
</tr>
<tr>
<td>M</td>
<td>102</td>
<td>93</td>
</tr>
</tbody>
</table>
### The ESCAPE trial of chest pain units

#### Table 20 Median time to see a treating clinician

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>D</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E</td>
<td>81</td>
<td>79</td>
</tr>
<tr>
<td>G</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>J</td>
<td>46</td>
<td>35</td>
</tr>
<tr>
<td>L</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>N</td>
<td>53</td>
<td>64</td>
</tr>
<tr>
<td>B</td>
<td>38</td>
<td>31</td>
</tr>
<tr>
<td>C</td>
<td>39</td>
<td>36</td>
</tr>
<tr>
<td>F</td>
<td>49</td>
<td>44</td>
</tr>
<tr>
<td>H</td>
<td>49</td>
<td>65</td>
</tr>
<tr>
<td>I</td>
<td>48</td>
<td>35</td>
</tr>
<tr>
<td>K</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>M</td>
<td>53</td>
<td>52</td>
</tr>
</tbody>
</table>

#### 4.8 Thrombolysis audit data

All participating hospitals provided thrombolysis audit data for both years of the study. Two hospitals (C and F) were unable to provide age and gender details. Three hospitals (B, C and H) were unable to provide symptom onset-to-needle time data. All hospitals provided call-to-needle and door-to-needle data.

A total of 2801 patients with ST-elevation myocardial infarction were audited at the participating hospitals. Mean age was 64.3 years (range 23–102 years), 1547 (69.5%) were male and 678 (30.5%) were female (576 had no gender recorded). Mean age and gender of patients attending CPU hospitals were 64.0 years and 70% male during the pre-intervention period and 63.7 years and 71% male post-intervention. These values for patients attending control hospitals were respectively 65.7 years and 68% male pre-intervention and 64.5 years and 67% male post-intervention. Patients attending when the CPUs were operational were not significantly different to those attending at other times: coefficient for age=0.9 years (95% CI, −1.4 to 3.2 years; \( p=0.460 \)), odds ratio for male gender=0.90 (95% CI, 0.62–1.31; \( p=0.593 \)). We did not adjust for age and gender in the subsequent analysis because these data were missing at two of the seven control hospitals.

Door-to-needle data were available for 2632 patients (94.0%) with a median time of 24 minutes (IQR, 15–53 minutes). Control hospitals tended to have longer door-to-needle times than CPU hospitals, but there was no difference in median times before and after intervention at either CPU hospitals (20 compared
The ESCAPE trial of chest pain units

with 21 minutes; median difference=0; 95% CI, –2 to 2 minutes; \( p=0.920 \); Mann–Whitney U test) or control hospitals (30 compared with 30 minutes; median difference=1; 95% CI, –2 to 3 minutes; \( p=0.587 \)). Data from the individual hospitals are shown in Table 21. The ratio of median door-to-needle time at CPU hospitals to control hospitals (adjusted for baseline differences) was 1.07 (95% CI, 0.90–1.27; \( p=0.458 \), rho=0.038).

Table 21 Median door-to-needle times

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>Difference (95% CI)</th>
<th>( p ) value (Mann–Whitney U test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17</td>
<td>19</td>
<td>1 (-3 to 5)</td>
<td>0.712</td>
</tr>
<tr>
<td>D</td>
<td>19</td>
<td>23</td>
<td>1 (-3 to 6)</td>
<td>0.469</td>
</tr>
<tr>
<td>E</td>
<td>17</td>
<td>25</td>
<td>3 (-3 to 9)</td>
<td>0.251</td>
</tr>
<tr>
<td>G</td>
<td>24</td>
<td>25</td>
<td>2 (-3 to 6)</td>
<td>0.061</td>
</tr>
<tr>
<td>J</td>
<td>17</td>
<td>18</td>
<td>2 (-3 to 7)</td>
<td>0.409</td>
</tr>
<tr>
<td>L</td>
<td>20</td>
<td>21</td>
<td>1 (-3 to 5)</td>
<td>0.495</td>
</tr>
<tr>
<td>N</td>
<td>24</td>
<td>22</td>
<td>-3 (-12 to 7)</td>
<td>0.503</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>21</td>
<td>0 (-5 to 6)</td>
<td>0.313</td>
</tr>
<tr>
<td>C</td>
<td>33</td>
<td>24</td>
<td>-6 (-11 to -1)</td>
<td>0.015</td>
</tr>
<tr>
<td>F</td>
<td>40</td>
<td>24</td>
<td>-7 (-16 to 0)</td>
<td>0.044</td>
</tr>
<tr>
<td>H</td>
<td>23</td>
<td>29</td>
<td>5 (1 to 10)</td>
<td>0.012</td>
</tr>
<tr>
<td>I</td>
<td>33</td>
<td>35</td>
<td>2 (-6 to 12)</td>
<td>0.674</td>
</tr>
<tr>
<td>K</td>
<td>27</td>
<td>36</td>
<td>9 (-3 to 25)</td>
<td>0.124</td>
</tr>
<tr>
<td>M</td>
<td>26</td>
<td>29</td>
<td>3 (-4 to 10)</td>
<td>0.402</td>
</tr>
</tbody>
</table>

Call-to-needle data were available for 2107 patients (75.2%) with a median time of 64 minutes (IQR, 48–93 minutes). There was no difference in median times before and after intervention at either CPU hospitals (64 compared with 64 minutes; median difference=0; 95% CI, –3 to 3 minutes; \( p=0.996 \)) or control hospitals (65 compared with 64 minutes; median difference=–1; 95% CI, –6 to 3 minutes; \( p=0.536 \)). Data from the individual hospitals are shown in Table 22. The ratio of the median call-to-needle time at CPU hospitals to control hospitals (adjusted for baseline differences) was 0.98 (95% CI, 0.87–1.11; \( p=0.781 \), rho=0.182).
The ESCAPE trial of chest pain units

Table 22 Median call-to-needle times

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>Difference (95% CI)</th>
<th>p value (Mann–Whitney U test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>56</td>
<td>60</td>
<td>3 (−5 to 11)</td>
<td>0.443</td>
</tr>
<tr>
<td>D</td>
<td>60</td>
<td>64</td>
<td>3 (−4 to 9)</td>
<td>0.424</td>
</tr>
<tr>
<td>E</td>
<td>54</td>
<td>59</td>
<td>3 (−5 to 10)</td>
<td>0.506</td>
</tr>
<tr>
<td>G</td>
<td>83</td>
<td>62</td>
<td>−18 (−30 to −7)</td>
<td>0.002</td>
</tr>
<tr>
<td>J</td>
<td>56</td>
<td>59</td>
<td>5 (−2 to 12)</td>
<td>0.238</td>
</tr>
<tr>
<td>L</td>
<td>54</td>
<td>63</td>
<td>3 (−11 to 15)</td>
<td>0.671</td>
</tr>
<tr>
<td>N</td>
<td>76</td>
<td>75</td>
<td>0 (−12 to 11)</td>
<td>0.978</td>
</tr>
<tr>
<td>B</td>
<td>70</td>
<td>73</td>
<td>8 (−9 to 24)</td>
<td>0.855</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
<td>61</td>
<td>−6 (−15 to 2)</td>
<td>0.156</td>
</tr>
<tr>
<td>F</td>
<td>88</td>
<td>75</td>
<td>−9 (−20 to 1)</td>
<td>0.078</td>
</tr>
<tr>
<td>H</td>
<td>54</td>
<td>64</td>
<td>9 (2 to 15)</td>
<td>0.009</td>
</tr>
<tr>
<td>I</td>
<td>77</td>
<td>71</td>
<td>−2 (−18 to 14)</td>
<td>0.496</td>
</tr>
<tr>
<td>K</td>
<td>67</td>
<td>73</td>
<td>6 (−10 to 24)</td>
<td>0.602</td>
</tr>
<tr>
<td>M</td>
<td>56</td>
<td>56</td>
<td>2 (−8 to 10)</td>
<td>0.696</td>
</tr>
</tbody>
</table>

Onset-to-needle data were available for 1854 patients (66.2%) with a median time of 155 minutes (IQR, 95–279 minutes). There was no difference in median times before and after intervention at either CPU hospitals (150 compared with 149 minutes; median difference=−2; 95% CI, −13 to 8 minutes; p=0.636) or control hospitals (165 compared with 160 minutes; median difference=0; 95% CI, −19 to 18 minutes; p=0.928). Data from the individual hospitals are shown in Table 23. The ratio of the median onset-to-needle time at CPU hospitals to control hospitals (adjusted for baseline differences) was 1.03 (95% CI, 0.87–1.22; p=0.733, rho=0.025).
The ESCAPE trial of chest pain units

Table 23 Median onset-to-needle times

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>Difference (95% CI)</th>
<th>p value (Mann–Whitney U test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>127</td>
<td>167</td>
<td>16 (−60 to 74)</td>
<td>0.626</td>
</tr>
<tr>
<td>D</td>
<td>151</td>
<td>137</td>
<td>−8 (−27 to 9)</td>
<td>0.353</td>
</tr>
<tr>
<td>E</td>
<td>160</td>
<td>177</td>
<td>15 (−10 to 45)</td>
<td>0.213</td>
</tr>
<tr>
<td>G</td>
<td>140</td>
<td>144</td>
<td>8 (−21 to 40)</td>
<td>0.644</td>
</tr>
<tr>
<td>J</td>
<td>97</td>
<td>106</td>
<td>8 (−17 to 30)</td>
<td>0.530</td>
</tr>
<tr>
<td>L</td>
<td>180</td>
<td>155</td>
<td>−10 (−47 to 29)</td>
<td>0.657</td>
</tr>
<tr>
<td>N</td>
<td>150</td>
<td>170</td>
<td>24 (−5 to 60)</td>
<td>0.111</td>
</tr>
<tr>
<td>B</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>C</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>F</td>
<td>171</td>
<td>159</td>
<td>−9 (−35 to 18)</td>
<td>0.515</td>
</tr>
<tr>
<td>H</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>I</td>
<td>205</td>
<td>156</td>
<td>−39 (−90 to 10)</td>
<td>0.104</td>
</tr>
<tr>
<td>K</td>
<td>192</td>
<td>220</td>
<td>20 (−44 to 120)</td>
<td>0.545</td>
</tr>
<tr>
<td>M</td>
<td>170</td>
<td>147</td>
<td>−9 (−51 to 30)</td>
<td>0.761</td>
</tr>
</tbody>
</table>

In summary, establishing CPU care had no significant effect upon door-to-needle, call-to-needle or onset-to-needle times.

4.9 Questionnaire responses

We selected 5584 consecutive patients for questionnaire mailing at 1 month after initial attendance; 200 before and 200 after intervention at each hospital, except for one hospital (K), where 188 were selected in the pre-intervention year and 196 in the post-intervention year. Mean patient age was 57.2 years and 57.7% were men. Patients attending CPU hospitals were older than those attending control hospitals in both the pre-intervention year (mean age 58.1 compared with 56.2 years) and post-intervention year (58.3 compared with 56.4 years), while the proportion of males was similar in the pre-intervention year (57.6% compared with 56.6%) and post-intervention year (58.1% compared with 58.4%).

In the pre-intervention mailing 1171 (42.0%) of the 1-month questionnaires were returned completed, 540 (19.4%) were returned uncompleted, 1025 (36.8%) were not returned, 36 (1.3%) could not be delivered and 16 (0.6%) of the sample had died by the time of mailing. The corresponding figures for the post-intervention period were 1218 (43.6%), 539 (19.3%), 982 (35.1%), 37 (1.3%) and 20 (0.7%), and were not significantly different (p=0.695). Three people requested translated questionnaires in the pre-intervention year (one
The ESCAPE trial of chest pain units

Punjabi, one Urdu and one Bengali) and two people in the post-intervention year (one Punjabi and one Urdu). Four of these were returned completed and one (post-intervention year) was not returned.

Table 24 shows the age and gender characteristics of responders (i.e. questionnaire returned completed) and non-responders (all others) at CPU and control hospitals in the pre- and post-intervention periods. Responders were consistently older than non-responders and there was some weak evidence that responders were more likely to be male than non-responders. Patients who were admitted to hospital were more likely to respond than those who were discharged (47.4 compared with 34.0%, \( p<0.001 \)) even after adjustment for age and gender (odds ratio, 1.61; 95% CI, 1.43–1.82%; \( p<0.001 \)). There was also some variation in response rate according to the month of mailing, but this was only significant for questionnaires mailed in February (37.2% responded, \( p=0.006 \)).

<table>
<thead>
<tr>
<th>Table 24 Age and gender characteristics of questionnaire responders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Responders</strong></td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>All participants</td>
</tr>
<tr>
<td>CPU hospitals</td>
</tr>
<tr>
<td>Control hospitals</td>
</tr>
<tr>
<td>Pre-intervention</td>
</tr>
<tr>
<td>Post-intervention</td>
</tr>
<tr>
<td>% Male</td>
</tr>
<tr>
<td>All participants</td>
</tr>
<tr>
<td>CPU hospitals</td>
</tr>
<tr>
<td>Control hospitals</td>
</tr>
<tr>
<td>Pre-intervention</td>
</tr>
<tr>
<td>Post-intervention</td>
</tr>
</tbody>
</table>

The pre-intervention response rate was significantly higher in the CPU hospitals (45.8 compared with 38.0%; \( p<0.001 \)), whereas there was no significant difference in post-intervention response rates (43.1 compared with 43.8%; \( p=0.710 \)). Although post-intervention response rates were similar at CPU and control hospitals, adjustment for the pre-intervention difference in response rates (along with age and gender) meant that attendance at a hospital with CPU care appeared to be associated with a lower probability of response (adjusted odds ratio, 0.70; 95% CI, 0.57–0.87; \( p=0.001 \), \( \rho=0.007 \)).

At 6 months after initial attendance we mailed questionnaires to all participants who completed and returned a 1-month questionnaire, apart from 20 (1.7%) in the pre-intervention phase and 12 (1.0%) in the post-intervention phase who had died by 6 months. In the pre-intervention mailing 940 (80.3%) of questionnaires were returned completed, 38 (3.2%) were returned uncompleted, 159 (13.6%) were not returned, 10 (0.9%) could not be delivered and there were other reasons for non-response for four (0.3%). The corresponding figures for the post-intervention period were 1012 (83.1%), 38 (3.1%), 146 (12.0%), seven (0.6%) and three (0.2%).
**The ESCAPE trial of chest pain units**

As with the first mailing, respondents were more likely to be older (59.7 compared with 56.0 years; \( p < 0.001 \)) and male (60.1 compared with 54.6%; \( p = 0.033 \)). Mailing in February was again associated with a lower response rate (75.4%, \( p = 0.038 \)).

### 4.10 Health utility

Mean 1-month EQ-5D scores were higher after intervention at CPU hospitals (0.631 compared with 0.677) and control hospitals (0.635 compared with 0.660). The effect of CPU care, compared to control hospitals and adjusted for age, gender and pre-intervention differences between CPU and control hospitals, was a non-significant improvement of 0.024 (95% CI, \(-0.029\) to 0.076; \( p = 0.379 \), \( \rho = 0.0070 \)).

Mean 6-month EQ-5D scores were also higher post-intervention at CPU hospitals (0.641 compared with 0.681) and control hospitals (0.658 compared with 0.679). The adjusted effect of CPU was a non-significant improvement of 0.021 (95% CI, \(-0.037\) to 0.077; \( p = 0.481 \), \( \rho = 0.0040 \)).

The mean area under the curve for health utility was higher post-intervention at CPU hospitals (0.3145 compared with 0.3334 QALYs) and control hospitals (0.3146 compared with 0.3253 QALYs). The adjusted effect of CPU was a non-significant improvement of 0.0084 (95% CI, \(-0.0168\) to 0.0337; \( p = 0.512 \), \( \rho = 0.0064 \)).

### 4.11 Patient satisfaction

Table 25 shows the results of the patient-satisfaction questionnaire. Mean pre- and post-intervention scores on the 5-point Likert scale are reported for CPU and control hospitals with the change after intervention and the estimated effect of CPU care upon satisfaction, compared to control and adjusted for age, gender and pre-intervention differences between CPU and control hospitals.

Before intervention patient satisfaction was generally higher at CPU hospitals than control hospitals. Scores did not change after intervention at the CPU hospitals but generally showed a small improvement at the control hospitals, so that the adjusted effect of CPU care was generally to reduce satisfaction by a small amount. This did not reach significance on any question, but approached significance for questions 4 (explanations given to you about medical procedures and tests) and 5 (attention given to what you had to say).
Table 25 Results of the patient-satisfaction questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean pre-intervention</th>
<th>Mean post-intervention</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question 1 The thoroughness of examinations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>4.05</td>
<td>4.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.86</td>
<td>3.95</td>
<td>0.09</td>
</tr>
<tr>
<td>Effect of CPU=−0.03 (−0.19 to 0.12; ( p=0.671 ), ( \rho=0.0142 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 2 The skill, experience and training of hospital staff</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>4.01</td>
<td>4.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.81</td>
<td>3.94</td>
<td>0.13</td>
</tr>
<tr>
<td>Effect of CPU=−0.06 (−0.21 to 0.09; ( p=0.411 ), ( \rho=0.0195 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 3 The thoroughness of treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.96</td>
<td>3.98</td>
<td>0.02</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.76</td>
<td>3.87</td>
<td>0.09</td>
</tr>
<tr>
<td>Effect of CPU=−0.05 (−0.22 to 0.12; ( p=0.529 ), ( \rho=0.0210 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 4 Explanations given to you about medical procedures and tests</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.65</td>
<td>3.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.42</td>
<td>3.61</td>
<td>0.19</td>
</tr>
<tr>
<td>Effect of CPU=−0.16 (−0.35 to 0.02; ( p=0.089 ), ( \rho=0.0091 ))</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Question 5 Attention given to what you had to say</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.62</td>
<td>3.63</td>
<td>0.01</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.38</td>
<td>3.56</td>
<td>0.18</td>
</tr>
<tr>
<td>Effect of CPU=−0.17 (−0.35 to 0.02; ( p=0.077 ), ( \rho=0.0052 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 6 Advice you got about ways to avoid illness and stay healthy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.03</td>
<td>3.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>2.89</td>
<td>3.03</td>
<td>0.14</td>
</tr>
<tr>
<td>Effect of CPU=−0.12 (−0.34 to 0.10; ( p=0.286 ), ( \rho=0.0049 ))</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Question 7 Friendliness and courtesy shown to you by hospital staff</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>4.15</td>
<td>4.19</td>
<td>0.04</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.88</td>
<td>4.03</td>
<td>0.15</td>
</tr>
<tr>
<td>Effect of CPU=−0.09 (−0.25 to 0.06; ( p=0.239 ), ( \rho=0.0133 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 8 Personal interest in you and your medical problems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.58</td>
<td>3.63</td>
<td>0.05</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.38</td>
<td>3.55</td>
<td>0.17</td>
</tr>
<tr>
<td>Effect of CPU=−0.10 (−0.29 to 0.08; ( p=0.274 ), ( \rho=0.0120 ))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Question 9 Respect shown to you, and attention to your privacy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.91</td>
<td>3.90</td>
<td>−0.01</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.61</td>
<td>3.75</td>
<td>0.14</td>
</tr>
</tbody>
</table>
The ESCAPE trial of chest pain units

<table>
<thead>
<tr>
<th>Question</th>
<th>Reassurance and support offered to you by hospital staff</th>
<th>Overall satisfaction with care</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean pre-intervention</td>
<td>Mean post-intervention</td>
</tr>
<tr>
<td>CPU hospitals</td>
<td>3.75</td>
<td>3.74</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.43</td>
<td>3.54</td>
</tr>
<tr>
<td>Effect of CPU</td>
<td>−0.11 (−0.30 to 0.08; p=0.252, rho=0.0153)</td>
<td>Effect of CPU</td>
</tr>
<tr>
<td></td>
<td>CPU hospitals</td>
<td>3.87</td>
</tr>
<tr>
<td>Control hospitals</td>
<td>3.60</td>
<td>3.72</td>
</tr>
</tbody>
</table>

### 4.12 Summary

CPU care was associated with the following changes in outcome, compared to control hospitals and adjusted for pre-intervention differences between CPU and control hospitals:

- weak evidence of an increase in the proportion of emergency department attendances with chest pain;
- no significant change in the proportion of patients with chest pain being admitted to hospital;
- a small increase in the proportion of patients with chest pain who re-attended hospital within 30 days and weak evidence of an increase in (re-)admissions;
- an increase in the mean daily number of medical admissions via the emergency department, without any significant decrease in medical admissions via other routes (although these findings were very sensitive to changes in the method used to handle missing data);
- a decrease in total emergency department waiting times but no significant change in waiting time to see a treating clinician;
- no significant change in time delays to thrombolysis;
- no significant change in health utility or satisfaction with care among patients attending hospital with chest pain.

None of the observed differences were consistent across the CPU hospitals and in some cases the establishment of CPU care at a particular hospital was associated with a change that ran contrary to the overall trend. We must therefore be cautious about drawing conclusions about the general effect of introducing CPU care.
Section 5 Qualitative findings: CPU acceptability

Emergency department staff at the seven participating hospitals were provided with a total of 186 invitation packs to give to selected patients who had either received CPU care or, if they attended a control hospital, would have been eligible for CPU. Some 32 patients replied, all of whom were contacted and the study discussed over the telephone. Twenty-six individuals consented to interview (14 intervention, 12 control), with no withdrawals. The response rate varied across sites, with more positive responses from sites in the Midlands than in the north of England. More males agreed to participate than females and respondents from control sites tended to be older than from intervention sites.

Some potential respondents found it inconvenient to engage in face-to-face interviews because of work commitments. We decided, with ethical approval, to include the option of telephone interviews to allow more people the opportunity of taking part. Individuals who preferred this option were asked to return a signed consent form in a pre-paid envelope prior to the interview taking place.

We were aware that data derived from telephone interviews may differ in respect to contextual detail and content, but this was preferable to the interview not taking place. In practice, three potential telephone interviewees did not return a consent form, and only two interviews were carried out using this method.

We carried out 24 face-to-face interviews and two by telephone. In the control group, there were five females and seven males aged 41–75, whereas the intervention group consisted of five females and nine males aged 34–68. All respondents were of British nationality (Table 26).

5.1 Interviews

A female health service researcher with a nursing background carried out all 26 interviews between November 2005 and August 2006. Interviews lasted between 30 and 60 minutes and were audio-taped. One interview took place on a hospital site, 23 in patients’ homes and two over the telephone. The semi-structured interview schedule was developed using relevant literature and expert advice. It was piloted in the first two interviews. Minor changes were made to the schedule, so that all data were included in analysis. Some issues that patients introduced into early interviews were explored in more detail later in the study.
### Table 26 Respondent characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Intervention/control</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Marital status</th>
<th>Home owner?</th>
<th>Diagnosis</th>
<th>Risk factors</th>
<th>Family/own history CHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
<td>F</td>
<td>51</td>
<td>Married</td>
<td>Y</td>
<td>Non-cardiac</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>F</td>
<td>46</td>
<td>Married</td>
<td>Y</td>
<td>Non-cardiac</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>M</td>
<td>65</td>
<td>Single</td>
<td>N</td>
<td>Angina</td>
<td>Stopped 3 weeks</td>
<td>Y</td>
</tr>
<tr>
<td>4</td>
<td>C</td>
<td>M</td>
<td>75</td>
<td>Married</td>
<td>Y</td>
<td>Atypical chest pain</td>
<td>Ex-smoker</td>
<td>Y</td>
</tr>
<tr>
<td>5</td>
<td>I</td>
<td>M</td>
<td>60</td>
<td>Married</td>
<td>Y</td>
<td>Epigastric</td>
<td>Never</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>M</td>
<td>41</td>
<td>Married</td>
<td>Y</td>
<td>Angina</td>
<td>Non-smoker</td>
<td>Y</td>
</tr>
<tr>
<td>7</td>
<td>C</td>
<td>F</td>
<td>73</td>
<td>Married</td>
<td>N</td>
<td>? Gallstones</td>
<td>Never</td>
<td>Y</td>
</tr>
<tr>
<td>8</td>
<td>I</td>
<td>F</td>
<td>47</td>
<td>Single</td>
<td>N</td>
<td>Panic attack</td>
<td>Stopped 5 years</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I</td>
<td>F</td>
<td>53</td>
<td>Married</td>
<td>Y</td>
<td>Panic attack</td>
<td>Ex-smoker</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td>M</td>
<td>59</td>
<td>Married</td>
<td>N</td>
<td>Non-cardiac</td>
<td>Cut down from 60 to 20 a day</td>
<td>Y</td>
</tr>
<tr>
<td>11</td>
<td>C</td>
<td>F</td>
<td>45</td>
<td>Married</td>
<td>Y</td>
<td>Panic/ palpitations</td>
<td>Non-smoker</td>
<td></td>
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<tr>
<td>12</td>
<td>C</td>
<td>F</td>
<td>68</td>
<td>Widowed</td>
<td>Y</td>
<td>Shingles</td>
<td>Ex-smoker</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I</td>
<td>M</td>
<td>34</td>
<td>Married</td>
<td>Y</td>
<td>Epigastric</td>
<td>Stopped 3 months</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>C</td>
<td>M</td>
<td>62</td>
<td>Married</td>
<td>Part own</td>
<td>Depression</td>
<td>Stopped 28 years</td>
<td>Y</td>
</tr>
<tr>
<td>15*</td>
<td>C</td>
<td>F</td>
<td>65</td>
<td>Divorced</td>
<td>N</td>
<td>Gastric</td>
<td>Non-smoker</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I</td>
<td>M</td>
<td>61</td>
<td>Married</td>
<td>Y</td>
<td>Angina</td>
<td>Cut down 25 from to 10 a day</td>
<td></td>
</tr>
</tbody>
</table>
The *ESCAPE* trial of chest pain units

<table>
<thead>
<tr>
<th>No.</th>
<th>Sex</th>
<th>Age</th>
<th>Marital Status</th>
<th>Heart Condition</th>
<th>Non-cardiac</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>I</td>
<td>M</td>
<td>Divorced</td>
<td>Non-cardiac</td>
<td>Stopped 6 years</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>C</td>
<td>M</td>
<td>Married</td>
<td>Arrhythmia</td>
<td>Stopped 20 years, Y</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>I</td>
<td>M</td>
<td>Married</td>
<td>Gastric</td>
<td>Non-smoker</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>I</td>
<td>F</td>
<td>Married</td>
<td>Angina</td>
<td>Never, Y</td>
<td></td>
</tr>
<tr>
<td>21*</td>
<td>I</td>
<td>M</td>
<td>Married</td>
<td>Indigestion</td>
<td>Non-smoker</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>I</td>
<td>M</td>
<td>Married</td>
<td>Angina</td>
<td>Stopped 3 years, Y</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>I</td>
<td>M</td>
<td>Married</td>
<td>Gastric flux</td>
<td>Non-smoker</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>I</td>
<td>M</td>
<td>Married</td>
<td>Angina</td>
<td>Stopped 23 years</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>C</td>
<td>M</td>
<td>Married</td>
<td>Angina</td>
<td>Stopped 2 years, Y</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>C</td>
<td>F</td>
<td>Married</td>
<td>Muscular</td>
<td>Non-smoker</td>
<td></td>
</tr>
</tbody>
</table>

*Telephone interviews.*
The ESCAPE trial of chest pain units

In the face-to-face interviews there was more opportunity for the researcher and the participant to develop a rapport, and the home setting allowed the patient context to be taken into account. For example, several of the interviewees had recently moved home and/or experienced upheaval in terms of home refurbishment. This had clearly been a source of anxiety. It was discussed as a result of inviting a stranger into what was considered a 'mess', and may not be discussed in an interview outside the home, or over the telephone. In addition, other potential risk factors, such as smoking, or obesity, could be observed without the need to ask for this information directly.

Other observations that placed the interviews in context were the relationships between interviewees and their families, and in particular, responsibilities that may affect how individuals react to hospital length of stay. For example, patients with young or unwell children were particularly keen for discharge, once their own condition was regarded as stable.

Four of the interviewees had experienced depression and/or alcohol abuse that was linked to relationship, home or work pressures. These were discussed openly, not necessarily as part of the interview, in order to provide a potential explanation for current situations.

5.2 Findings

Overall, respondents expressed a high level of satisfaction with the care they received, both in intervention and control sites. Indications of difference between care experiences were more marked between each individual site than between CPU and control sites. The data providing possible reasons for this will be discussed in this section, which will also focus on the strengths and weaknesses of chest pain care from the patient perspective.

5.2.1 The chest pain pathway

For patients, the onset of chest pain was the beginning of a care experience that continued until after discharge. The pathway can however, be divided into three distinctive phases: dealing with chest pain, experience of CPU or emergency department care, and discharge and beyond. Each of these phases will be discussed in turn.

Phase 1: Dealing with chest pain – ’better to be safe than sorry’

This section presents findings from the data relating to the period of time between onset of symptoms and arrival at hospital. It includes findings addressing the experience of and reactions to chest pain, and issues around health care seeking. The data fall into the following sub-themes: chest pain as a warning, and chest pain as a problem. Respondents described their chest pain symptoms experienced prior to the seeking of medical help, and ultimately arriving at one of the hospital emergency departments. During interviews, patients attempted to make sense of this period of time, which varied in length from minutes to days. Participants talked about meanings that were evoked by
The ESCAPE trial of chest pain units

bodily sensations and their own and other’s reactions that stemmed from these meanings.

Chest pain as a warning

The onset of chest pain symptoms was often described in the context of an interruption to daily activity or night-time sleep. Despite the time lapse between the event and the interview, the memories of chest pain and related symptoms remained graphic, with analogies and sound effects used to convey the change in bodily state. There was no ‘typical’ description (in the following, I means intervention group, C means control group):

*My heart was doing a whooshing sound, it wasn’t just beating, there were all sorts of dance movements (laughs) that shouldn’t be there.*

(Female, 45, non-cardiac, C)

*It felt as if I’d got, sort of felt as if I was in a straight-jacket, my chest, it hurt.*

(Male, 59, angina, C)

*It was just like, this one was just like a dull ache, but it was quite high up, and then sometimes my arm would ache as well with it; it was as if somebody was pressing, pressing on my chest, but as I say, it wasn’t severe enough to stop doing anything, so, or even bad enough to take anything...and I don’t know if you imagine it because you have a bit of knowledge, but I thought that my left arm was aching, things like that; but I don’t know whether it was, you just imagine it don’t you because you associate it with the left side, cardiac pain.*

(Female, 51, non-cardiac, I)

Reactions to the symptoms included fear of a heart attack, and the implications of this; however, some experiences were less extreme and dramatic. Respondents tried to make sense of what was happening, and in some cases, used a variety of techniques to try and ease the symptoms. These included splashing the body with cold water, resting, and taking medication. Prior experience and knowledge were called upon during this time. Two of the interviewees who were health care professionals still found it difficult to assess their own symptoms decisively. Attempts at self-diagnosis were difficult because the subjective experience of pain does not always match textbook descriptions of the pain. In addition, pain can interfere with clear thinking, and symptoms can be exacerbated by anxiety, for example anxiety due to fear that one might be experiencing a potentially fatal heart attack:

*I found, if I got a little bit upset, ‘cos I was scared, the pain came worse than it were, and at the back of it, just a normal pain, if you know what I mean, it’s so frightening.*

(Female, 53, non-cardiac, I)

*I wasn’t too worried as such, but it was severe, it was really bad, but erm, basically just try to get yourself calm and not, because, to be honest, if I'd worried about it, or started sort of running around saying ‘what’s happening’, that could have made it worse anyway, so it was a matter of trying to keep myself calm and wait till the ambulance got here, so I didn’t flap or anything.*

(Male, 41, non-cardiac, C)

Interpretations of the chest pain symptoms and patients’ understanding of it, particularly their own prognosis and imminent care arrangements, were often affected by the presence or absence of a family history of CHD:
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It damn well hurt! It hurt, and my father died of a heart attack, my aunt and uncle died of heart attacks, so it’s er, I quite expected to come out feet, well, not, I’d have known I’d gone in, but not known I’d come out, and that’s….I felt absolutely terrified.

(Male, 59, angina, C)

I didn’t think it was anything to do with my heart, because I’ve never had heart problems, never had high blood pressure, no-one in my family’s ever had heart problems, so I thought ‘no, it’s probably not that at all, but let’s just check it out in case’, because once you get to sixty you start thinking.

(Female, 59, non-cardiac, C)

Symptoms therefore held different meanings for individual respondents and their family and friends. Therefore reactions to symptoms also differed.

Chest pain as a problem

Chest pain symptoms posed a problem in terms of what to do next. Accounts showed a common reluctance by individuals experiencing chest pain to involve health care services unnecessarily. Health care seeking therefore varied according to several factors including the presence of others at the time of onset, the relationship of the third party to the patient, the severity of symptoms, health beliefs and past experience. Delays in seeking help ranged from minutes to days. The distribution of help sought is displayed in Table 27.

Table 27 Modes of health care seeking

<table>
<thead>
<tr>
<th>Options chosen</th>
<th>No. of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency services</td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
</tr>
<tr>
<td>Emergency department</td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
</tr>
<tr>
<td>GP/walk-in-centre</td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
</tr>
<tr>
<td>Phone NHS Direct/emergency GP/hospital</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
</tr>
</tbody>
</table>

All calls to NHS Direct, GP and hospital were followed up with emergency services. Two general practice visits resulted in referral to the emergency department with no ambulance (one patient refused).

Incidents in the workplace invariably resulted in emergency services being called, or a colleague driving the patient to hospital. Domestic situations were more varied, with delays caused by negotiations, indecision or attempts to wait and see whether the symptoms would subside.

Now, I drink gallons of that, not literally, but spoonfuls of Gaviscon, and it won’t remove it, so then the wife starts panicking then, ‘I’m gonna get the doctor, I’m gonna get an ambulance’, I go ‘I’m alright, you know, just give me a few minutes
The ESCAPE trial of chest pain units

and I'll, I'm hoping it'll all be gone', but, it doesn't go...that's the start of it, then the ambulance comes after she's called it.

(Male, 75, no diagnosis, C)

I think if I had been [husband] I'd have insisted on that [ambulance] but I think it is the Englishness in us, the thought of 'Oh, it's OK, we'll manage, we'll cope', it's ridiculous, it really is ridiculous, but we do it. But I went, and I was reassured, and I did feel better.

(Female, 45, non-cardiac, C)

In 11 cases a health professional was approached, either by telephone or in person, to make the often difficult decision of how to proceed. A minority of patients were concerned enough to seek help themselves. Those alone at the onset of symptoms were least likely to call an ambulance. Two respondents had driven alone in search of help.

It started the night before, and I went to (hospital), but with all the trouble with parking, I decided to come home! ... So I decided to go in the morning, that would be the easiest thing to get parked up and that, so I went in the morning.

(Male, 35, non-cardiac, I)

It appears from the accounts that decisions required assessing risks and costs of either calling or not calling an ambulance. In other words, balancing one's own health and safety with the potential inappropriate use of NHS resources, and personal stigma or embarrassment.

I felt ashamed...I don't know, it's 'Oh, they're coming out to me, and there's probably somebody dying by the side of the road...you know, that could do with this ambulance, and I'm taking up this ambulance's...but it is, it's embarrassing, and you're thinking to yourself, you actually start regretting, in a sense...because you just feel as if you've wasted everybody's time!

(Female, 47, non-cardiac, I)

For the third party, however, there appears to be a bias toward seeking help that is mediated only by the patient's reluctance. This may be due to a sense of responsibility, particularly in the workplace and in social settings, that overrides attempts by the patient to negotiate waiting time. Individuals who are closer to the patient will be more aware of their preferences and health beliefs, as well as previous experiences that might deter immediate action, but will balance this with a sense of responsibility. The patient is the only person that can feel the symptoms and may not accept that their chest pain is severe enough to warrant urgent attention, particularly if there has been no previous family or personal history of cardiac illness.

Phase 2: Experience of the CPU or emergency department care

This section presents the findings from the part of the pathway that includes expectations of, and attendance at, a CPU, or usual care in an emergency department. It addresses the differences between expectations and reality, interactions with health care professionals, information giving and issues around diagnosis.
The ESCAPE trial of chest pain units

Expectations versus reality

Prior experience and media representations were major influences on patient expectations following the initial seeking of medical advice. Some respondents had previous hospital experience of check-ups and tests. Others had attended an emergency department for a non-urgent condition, or with a relative. Some participants had no prior experience or expectations at all.

The main expectations expressed were negative, and related to waiting times and departmental organisation. There has been much publicity in recent years about long waiting times generally, and particularly in emergency departments (Department of Health, 2001). Waiting for attention cannot be controlled by patients and is seen as unnecessary time spent in hospital, away from home and work responsibilities. Based on news items and previous experience, some reported a dread of attending the departments. For the participants, the reality was different to expectations, possibly because of the urgent nature of chest pain.

“I've sent people to A&E [Accident and Emergency], erm, knowing that, I used to work in a hospital, and if people had problems you'd say 'go to A&E', and you know they'd be there 8, 9, 10 hours and I was quite prepared for that, and it was a surprise to go there and, you know, be right in there sort of thing.”

(Male, 60, non-cardiac, I)

This aspect of care was the most frequently cited in statements of satisfaction; expectations were exceeded.

“You hear stories about people lying around in A&E for hours on end; nobody attending to them – that didn’t happen to me, I was attended to immediately.”

(Male, 65, angina, C)

Despite expectations of long waiting times in the emergency department, there was a tendency for respondents to underestimate length of hospital stay. One intervention site had a system-induced delay for blood test results, requiring that patients stay overnight. Respondents generally expected to go home the same day.

“When I went into hospital, well, I thought I was just going to have a check, staying overnight was a bit of a surprise, the main concern was how long am I going to be in there, for a start, then I expected to, I didn’t really expect to be finished there and then, I felt as though they would obviously do tests…and that was it, tablets, home, away.”

(Male, 65, angina, I)

“I did think erm, to be honest that they would just check me over in A&E, and then I would be sent home, but obviously they've got to be sure before they can do that, so erm, when they said I'd got to go on the ward, I really wasn't surprised, and I knew what they were doing.”

(Male, 73, angina, C)

The time of day people attended the department was also a factor in the length of stay, due to nurse shift patterns and availability of investigative technology. For example, patients attending late in the day would invariably have an overnight stay, whereas some day-time attendees in control sites could be discharged within 3 hours. The CPU protocol demands that patients are
**The ESCAPE trial of chest pain units**

monitored for a minimum of 6 hours, which may affect length of stay compared to control sites.

*I was then on a, what I think was a like a cardiac course thing, you know, they like to keep you so many hours, give you so many blood tests, so many blood pressure tests, and ECGs over a period of 8 hours, just to see how you are at each stage, and I think it’s one of each every 2 hours, and they monitor over that period – you’ve got to stay there that period, you’ve got to stay there the 8 hours, so that’s what happened, yeah.*

(Male, 61, non-cardiac, C)

Care pathways appeared to vary between sites. Patients seemed somewhat vague as to where they had been cared for, particularly if moved from the main emergency department area. Some patient care was carried out away from the area in which CPU staff or chest pain nurses were based, so that the relationship between nurses and patients lacked continuity.

**Interactions with health care professionals**

Attendance at the emergency department or a CPU prompted a range of interactions with health care professionals. Whereas a major feature of the CPU protocol is that care is carried out by specialist cardiac nurses, in reality this varied between sites. Specific nurse roles differed across all intervention and control sites. For example, continuity of specialist nurse care was described by patients from one of the control sites, and less so at one intervention site.

Experience of continuity of care also appeared to be dependent on site-specific specialist nurse cover. This varied in the four CPUs from two nurses covering 5 days to seven covering 7 days. However, specialist nurses were not always based permanently in the CPU. In addition, the movement of patients through units and wards meant more possible interactions with a greater number of staff, with less focus in some accounts on the relationship with specialist cardiac nurses.

However, whatever type of care structure was being delivered, patients valued certain attitudes from health care professionals during interactions. In particular, calmness, reassurance and humour were important aspects in reducing fear and maintaining a link with ‘normality’ in a seemingly alien environment.

*You’re in unfamiliar surroundings, in an unfamiliar system, and you just feel like a fish out of water, and for somebody to come in…it may be just talking about their kids, something you can relate to, ‘cos in the situation there’s an awful lot of things you can’t relate to, you know, you’re at someone else’s, you know.*

(Male, 60, non-cardiac, C)

In particular, patients valued the time and attention that specialist nurses were prepared to give.

*The chap that met us there was a delight, he was a really nice person, I can’t remember his name, but he said that he was the cardiac nurse…he was the main one, the doctor came in and did his stuff, you know, listening through a stethoscope, patted my back, and he instigated the blood and the results of that, but that was all, really, it was mainly the cardiac nurse…he was very gentle, really lovely.*

(Female, 45, non-cardiac, C)
The ESCAPE trial of chest pain units

In contrast to the above patient’s experience, at one control site interactions with health care professionals were described in a fragmented way. Patients rarely knew who they had been talking to, either by name or designation.

"The first person that came to see me was I think, a staff nurse, and she said ‘we’ll get you, you know, we’ll get you into this bay’, and, then I saw a series of people, somebody came to weigh me, somebody came to do the injections, somebody came and put the cannula in, and then somebody else came to do something else, and I didn’t know their names, or ranks, or whatever."

(Male, 73, angina, C)

A small number of respondents had expected more medical input. This appears to have been due to a lack of awareness of extended nurse roles, rather than disappointment in care delivery. Specialist nurse care was regarded as acceptable, if not preferable, particularly in terms of knowledge and empathy.

"I just think this one particular, the chest nurse, she’d got a real good handle on what’s going on, really, the one good thing that came out of it, very knowledgeable, and she obviously called in a few favours to get me on this treadmill, which was good of her, you know."

(Male, 38, non-cardiac, I)

The specialist nurse is well placed to establish a relationship within which patient values, preferences and concerns can be assessed and addressed. Within this study, the experiences of such a relationship are described in a positive way, but are not evident in all cases. The role of the specialist nurse was described as just as valuable in one control site as in intervention CPUs.

Length of stay

The amount of time patients spent in hospital was an important issue for the researchers. The data indicate it was just as important to the respondents. The CPU protocol aims to eliminate initial waiting times, and reduce admission rates. None of the respondents from CPU sites claimed to have waited to be seen by a professional on arrival, compared to one patient who waited 10 minutes at a control site.

Most respondents preferred to spend as short a time as possible in the hospital, unless there was a clinical rationale for staying, in which case some patients felt safer than at home.

"I must say I was relieved that I, you know, to get it all done there and then, and not a case of, you know, the ECG, bloods done, and then being admitted onto medical admissions unit which would, I mean, it’s a nightmare there ‘cos it’s so busy, so, the fact that I could have, you know, waiting around for an hour, that was fine."

(Female, 51, non-cardiac, I)

"It was a bit uncomfortable, but I didn’t mind… I felt, I felt more assured being there than I did, if you know what I mean, all night, I didn’t mind being there, rather than being at home or somewhere else."

(Male, 65, angina, I)

Reasons given for wanting to leave hospital as soon as possible included a dislike of hospitals because of negative emotions evoked by the smell, feelings of
The ESCAPE trial of chest pain units

responsibility at work and home, and feelings of guilt for wasting NHS resources. In addition, waiting around was seen as frustrating or boring:

I sat in the observation ward for 8 hours, that’s awful, having to sit there, luckily I’d taken, I’d had presence of mind to take my bag, I carry, a carrier bag, with my glasses and my book in, Oh, was I thankful I’d done that, so I’d got a book, so I finished that in 8 hours.

(Male, 61, non-cardiac, I)

Some patients used tactics in an attempt to shorten their stay in hospital. Examples included ‘promising’ to return next day to complete investigations, and playing down symptoms. Length of stay was extended when patients needed to wait for blood tests, results from investigations, medication, or an exercise test. In one CPU site, patients were surprised to be kept in overnight.

They did the ECG and what they do now, they keep you in overnight because prevention is better than cure, and I ended up staying here overnight, and the following morning I went on the treadmill, and they did the blood tests…I was quite shocked to be kept in, I’d made no provision, you know, left lights on at home, so...

(Male, 60, non-cardiac, I)

Some patients had to wait to be seen by a medical officer prior to being discharged. This could take hours, and was particularly frustrating if there was a lack of communication regarding the expected procedure.

Someone else could have been using that bed, erm I mean, I was well enough to go home, even if I had to sit and wait, so yeah, it was really the waiting, and I understand about the early hours, having to wait for a doctor, but it’s afterwards, it’s all the time you have to wait just to say ‘yes, you can go home’.

(Female, 59, angina, I)

The responses show a preference for short-duration stays; however, there is also concern not to feel ‘rushed in and out’, in other words, patients need to feel that there is adequate time for their needs to be met; this is particularly pertinent to information-giving.

Information-giving: investigations and interventions

All respondents expressed satisfaction with their care. However, some respondents expressed a need for more information-giving. The data indicated that expectation of, and perceived need for, information differed between individuals. For this reason, a standardised optimal approach is problematic. In addition, it is not clear whether some patients were disappointed with the level of information they received at the time they were in hospital or whether this aspect of care had been reflected upon after discharge. It may be that patients realise there has been a shortfall of information when discussing their experiences with friends, family, GPs and researchers:

You know when you’re having a conversation when you’re half asleep, so I didn’t really pay attention, but that’s it, done, so I would have probably asked him more, you know, what, ‘cos he said there was this…to be fair to him, he looked and said whatever it is, ‘it’s normal for you’, but it would have been quite interesting to say ‘well, what is it, and how does it manifest itself, and can it, you know, be managed’ sort of thing.

(Male, 38, no diagnosis, I)
The ESCAPE trial of chest pain units

They can tell if you’ve had a heart attack, the blood tests, but I didn’t know that, so that’s why I gathered they took them, to test, ‘cos my sister is a sister in a hospital, she said that’s what they took them for.

(Male, 65, angina, I)

Quite often, patients reported being content to have survived their chest pain experiences, and were grateful to health professionals for carrying out their work in an efficient manner. Others, however, whether retrospectively, or at the time, considered that they knew little about what had happened to them, particularly in terms of investigations and results. For example, whilst all respondents described having had blood tests during their stay, only eight showed an awareness of the actual reasons for taking the blood. Even fewer recalled explanations of the results and their implications, once they were obtained.

You just merrily put your arm out, don’t you, and they take a blood test…but I didn’t know, I just assumed that they were for something that would presumably point them in the right direction of what had happened, I don’t know, but they don’t actually say…they just you know ‘don’t worry, this won’t hurt’, and then they take it, you know the blood test, so I don’t really know what it was for, not specifically, anyway.

(Female, 59, angina, I)

Although some respondents felt that being given the ‘all clear’ was acceptable without further discussion, others would have preferred to know what this phrase meant in terms of how their results compared with optimal parameters. It may be that at the time, patients are relieved to be told that they have no cardiac abnormality, and are eager to return home, and therefore omit to ask questions, or even forget information they have received, particularly if anxious at the time of delivery.

Diagnostic reassurance

Following the analysis of test results most patients in this study received either a diagnosis or reassurance that there was no cardiac origin to their chest pain. Non-cardiac chest pain diagnoses included panic attack, depression/anxiety, muscular spasm and gastrointestinal disorders. Angina and arrhythmia were the only cardiac-related diagnoses in the sample. There were however, five respondents who, though cardiac-related cause was ruled out on attendance, remained unsure about the cause of their pain at discharge. For three of these, uncertainty was accompanied by frustration.

‘It’s not a heart attack (or a what-you-call-it), see you later’. OK, well, fine, check me in to see if it was that or not, it’s not, but it was something, you know, there was something going on, it’s that not knowing really, you know, ‘I initially thought it was that, it’s not that, see you later’, and I suppose the difficulty is then, is like, you want to check through everything, might it still be there now?

(Male, 38, no diagnosis, I)

When you get that kind of information you think ‘Oh, that’s a waste of time’, that’s the thing that I don’t like about it, you see, that now, I think I’m a fraud because there was nothing wrong with me, although there was, they can’t prove it.

(Male, 75, no diagnosis, C)

Differences in chest pain care protocol meant that patients receiving CPU care had already performed an exercise test, if appropriate, shortly after discharge.
The ESCAPE trial of chest pain units

In contrast, respondents from control sites were still waiting for an appointment at the time of interview, creating a potential period of diagnostic uncertainty compared to patients from CPU sites. However, the impending test could also provide a needed link with the unit after discharge that is not available to those who have already been tested but have not received a diagnosis.

**Phase 3: Discharge and beyond**

This section provides the findings that focus on the last part of the patient journey and care pathway; that is, discharge from the unit and its aftermath.

**Discharge process**

A small proportion of respondents were admitted to a ward for further monitoring and investigations. These patients understood the reasons for their admission, and found this acceptable. Patients felt safer in hospital in these cases. However, for those whose investigations showed no sign of cardiac involvement, and once symptoms had subsided, the main concern was to return home to normality, comfort, and the resumption of responsibilities that have been suspended or delegated to others:

All these things have gone through your head ‘well, that’s good, I’m going to be alright, that’s absolutely fine, let’s get out of here!’ My thoughts went onto here, you know, it’s like it’s 8 o’clock or something, in the morning, and they’ll not be up yet, I’ll just sort of go in and have some breakfast, and still be there when (daughter) gets up, and, so I threw my thoughts and my consciousness into the future, to get on with my life, really, so I think mentally, I was out of there.

(Female, 45, non-cardiac, C)

Most respondents reported that the decision to be discharged from hospital was made by medical personnel. In one intervention site, the specialist nurse seemed to have more autonomy in this area. Waiting for results, the availability of a doctor and/or medication created delays in the discharge procedure in some intervention and control sites. Some respondents recalled the frustration of being told they were ‘all clear’, but having to wait, sometimes for hours.

Well, then I never got away from there until…I got home at 5 o’clock, so I suppose all in all, yes, when he told me I could go home at midday or just after, it’s a long time sitting around waiting, but the things you wait for there are the prescription to be made up, put up and brought back to the ward, or collected. And the other thing is the doctor’s letter, and whether he’s got time to either dictate, or whatever they do, obviously he’s got to dictate, and then you’ve got to have three copies, obviously, so that also takes up time I can appreciate that, but it seems to go on for a long time and you think ‘for Goodness’ sake, let’s get this thing done’.

(Male, 73, angina, C)

In addition, patients who now saw themselves as ‘well’ experienced a sense of guilt for using NHS resources.

Once they were sure that my blood pressure was fine, I felt even more fine, and that’s when I started feeling guilty…but it was even worse when they said they were going to keep me in overnight, erm, to do more tests, because apparently, so many hours after the incident, they need to take more blood, so then I feel ultra-guilty.

(Female, 47, non-cardiac, I)
The ESCAPE trial of chest pain units

I felt a bit of a fraud actually, because I sort of had an idea of what it was, and you know, you think to yourself 'there could be people having heart attacks and I'm taking a bed up', you know, that type of thing.

(Male, 60, non-cardiac, I)

Respondents were asked if they had been referred to any other institutions or health care professionals at discharge. All GPs are informed of the attendance and test results, but only those with a cardiac diagnosis received a referral to another specialist; two of these reported communication issues between hospitals that resulted in delayed appointments. In non-cardiac cases, there had been no specialist referrals. Advice giving prior to discharge was also focused on cardiac conditions. Patients with a diagnosis of angina were aware how to self-medicate, and when to seek medical attention. However, one respondent who was given verbal and written information was unclear about how much he could exert himself to maintain an active life without inducing chest pain:

I don't know what to do with myself, that's the thing, and I think they say do a certain amount of exercise, so I do that, and then I think 'well, I'll try and see how things are going, be a bit more energetic'...I might think 'well, should I go back to tennis', this is the thing, and I think 'well, they say no' so I don't, but against that I tend to think that probably I could, so...

(Male, 68, angina, I)

For those with non-cardiac diagnoses, advice within the emergency department or CPU was less accessible. With the exception of one interviewee who was given advice for his gastrointestinal disorder from a nurse who had specific knowledge of this area, there was no formal advice given. These patients were referred to their own GP for follow-up.

Reflections

The period between attendance at the emergency department or CPU and the research study interview averaged 4 weeks. During this time some patients experienced mild recurrence of symptoms. Eleven reported having attended their GP to discuss their diagnosis. This had been a time for reflection about personal health issues, the chest pain care experience and the health system.

It was assumed that if similar symptoms were to recur, care would be carried out at the same site (apart from two respondents who were travelling out of town at the time of onset). As satisfaction with the quality of care and interactions was high, none of the respondents were concerned about re-use of CPU services. In fact patients had been pleasantly surprised, and in many cases their fears had been alleviated.

I'd only go to (trial hospital) again, I wouldn't go anywhere else...they were so friendly.

(Female, 53, non-cardiac, I)

Well, I don't want to go back there, but I wouldn't be as worried this time round, next time round if I did...about what's going to happen when I get there..., nobody threw up, and nobody burst out laughing at me, nice people, they must see worse, I suppose!

(Female, 47, non-cardiac, I)
The ESCAPE trial of chest pain units

I do feel apprehensive the way it came on, and that could happen again, erm that worries me, but I felt very confident that I’d been given the full MOT, for want of a better word.

(Female, 59, angina, I)

In two cases there was a reluctance to use emergency services again. In these two respondents no cardiac abnormality had been found. However, one claimed he would call an ambulance in future as there are so few parking places.

There was some ambiguity in terms of re-use of services for the group of individuals who experienced a panic attack or palpitations. At the time of onset, symptoms are very frightening, but with hindsight the event appears more trivial. For this reason, there is a higher level of embarrassment involved in using services. These patients were very sensitive to signals from staff and in particular were worried about being ridiculed.

I think they understand, they do understand the emotional side of things of the incident as well. By the time you get there, and it’s not doing it any more, all I had was a tight chest, no whooshes on the monitor (laughs), I’m sure they know it could happen to anyone.

(Female, 45, non-cardiac, C)

In contrast, individuals with a definite diagnosis of angina were relatively clear about the need to return to hospital. However, there were concerns in terms of speed of access to hospital where the hospital was some distance away.

The experience of acute chest pain had come as a surprise for many of the interviewees. This experience challenged their assumptions about the future, and lifestyle choices. Some had also been affected by the experiences of other patients while in hospital. The risks of smoking, stress and lack of exercise were re-assessed, and priorities altered to capitalise on improved health and contentment.

A lot of things used to wind me up…. Now, I just let it go straight over the top and it’s as simple as that, and yes, I feel better for it, I feel a lot better in myself for cutting down on cigarettes, I’m not so out of breath and all the rest of it…there’s always someone in there that’s worse off than you, always, and you think to yourself ‘you’re not so bad, just slow down’.

(Male, 59, no diagnosis, C)

Reflections also included broader issues of service delivery. Two respondents spoke of local hospital closures that resulted in extra travel, and associated time, cost and inconvenience, to arrive at an emergency department.

If they gave us the three hospitals back, that they took away, then (X hospital) would be brilliant, as an addition, but to shut…and there were people coming through ‘where have they come from?’ ‘they’ve come from (Y town), so the ambulance goes to (Y town) sshhh…takes them to (X city)’.

(Male, 35, non-cardiac, I)

As already stated, patients generally expressed satisfaction with the care and treatment received during their attendance, but it may have been through reflection, with the advantage of clearer thinking and hindsight, that aspects such as information-giving became relevant. Allowing patients to share these reflections can therefore provide valuable insights about how people cope with
The ESCAPE trial of chest pain units

their chest pain experiences, and how services can better meet the needs of service users.

5.3 Discussion

Individuals who attended one of four CPUs or three emergency departments with acute chest pain were asked about their experiences and views about the services. Respondent accounts indicate high levels of satisfaction with the care in all sites. However, each patient’s experience was different regardless of whether their care was delivered in a CPU or as normal care. Therefore, a clear distinction between CPU and control site experiences cannot be made. Patients differed in terms of pain experience and how pain was interpreted. This in turn influenced how services were accessed, and delays in seeking help. Wherever care was delivered, there were aspects of care that emerged as important in terms of quality, although these aspects varied in accessibility across sites. Important aspects of care were access to specialist nurses, length of stay, information giving, diagnostic certainty and aftercare. The main findings will now be discussed in turn and in relation to existing literature.

5.3.1 Chest pain experience and health care seeking

The experience of chest pain differed across the sample, whether patients attended a CPU or not. This highlights the range of causes of chest pain within the sample, and also individual perceptions of pain. Reactions to chest pain also varied. The sample reflects a group of people that, however reluctantly, sought medical assistance. However, there were some delays before medical help was sought. These were mainly influenced by severity and type of pain, although previous knowledge and experience, and the presence of other individuals, were also factors. Whereas some respondents described severe symptoms, and were keen to seek immediate medical attention, others sought the opinion of health professionals mainly to rule out cardiac problems, and/or make the decision of whether further action should be taken. The decision to use emergency services was usually taken by people other than the patient, the latter often feeling unsure of the medical urgency, embarrassed or reluctant to use NHS resources. Where a spouse was present, a discussion often preceded the decision to seek medical attention. Such discussions are likely to occur because of a tendency for spouses to want to act in a protective manner compared to the participant. This tendency has been described in previous research with people who have a known diagnosis of angina (Furze et al., 2001). Our study findings add that spouses present at the onset of chest pain showed a tendency to protect the participant regardless of whether there was a known history of CHD. This is probably due to a fear of impending heart attack, which may or may not be shared by the patient.

This study also showed a tendency for people other than spouses to seek help on behalf of the respondents. This may again be related to protective behaviour, and feelings of responsibility for the well-being of others. In addition, health and safety legislation may have had an effect on the health care-seeking behaviour of others at work and in public places. This is supported in part by previous work on health care seeking for cardiac symptoms. In particular, Brown et al. (2000)
**The ESCAPE trial of chest pain units**

found that bystanders are more likely to contact the emergency services than the individual experiencing symptoms. As Meischke *et al.* (2000) have found, patient embarrassment may be a potential barrier to the use of emergency services, particularly if the call may be seen as a false alarm. Moser *et al.* (2005) showed that women in particular were reluctant to seek help as it might cause trouble for others. Some respondents in our study discussed their feelings of embarrassment and stigma that were evoked by the arrival of emergency personnel. This is because such an event is highly visible and links the individual with some form of physical incapacity. These factors highlight the difficulty in decision-making for individuals who are ambivalent about taking action on the basis of their own symptoms. Our study extends previous findings in that females appeared as concerned about the potential threat of chest pain as their male counterparts, particularly when there was a history of CHD in the family. Individuals may also feel more at risk with increasing age, although this cannot be clearly associated with health care seeking in this study. We could not evaluate responses from those who sought no help at all; therefore a fuller explanation for delay in health care seeking will require further research.

### 5.3.2 Specialist nurse care

Generally, respondents were complimentary about the provision of services in both intervention and control sites, as well as the emergency services. However, when questioned in more detail, certain aspects of care delivery were emphasised. Differences between individual sites emerged. Specifically, there was variation in terms of access to a specialist nurse. Satisfaction with information giving appeared to be related to continued accessibility of specialist nurses. This may increase the opportunity for patients to develop a relationship in which information giving can be tailored to individual needs and expectations. This finding is supported in a review of nurse substitution in primary care (Laurent *et al.*, 2006). It concludes that nurses tend to give more information than doctors and that quality of care and health outcomes are comparable with those associated with doctor-led care. In our study it was also found that time taken to be discharged may be associated with specialist nurse autonomy as a substitute for medical decision-making. The autonomy to discharge at least some patients without reference to a medical officer may therefore reduce delays in discharge. However, as Norris and Melby (2006) have shown, professional autonomy of nurse specialists can be restricted by inter-professional conflicts. For this reason, an effective collaboration between professional groups can be regarded as beneficial to patient care.

Whereas interactions with medical staff and other nurses were for the most part valued positively, many accounts highlight the added value of the specialist nurses’ contribution to care. Read (1999) and Read *et al.* (2001) explored new nurse roles, and found that patients were not concerned about the professional designation of practitioners, but valued highly and supported the extended services delivered by nurses, particularly in terms of continuity and quality of care. In our study, some patients expected medical staff to be more visible in terms of interactions, but were not dissatisfied with specialist nurse care, which was regarded as highly competent and knowledgeable. Work around extended nursing roles supports the findings of this study in terms of patient acceptability.
In addition, the care of chest pain patients by nurses has been shown as safe and effective (Way et al., 2007). In terms of individual interactions, White (2003) cited the use of ‘banter’ in nurse–patient interactions as a possible coping strategy for men admitted with chest pain, replacing the discussion of emotional issues. In our study, a calm reassuring manner, and friendliness/humour, helped to alleviate patient’s fear and anxiety, regardless of whether they were male or female. This was important to some patients in order to create a sense of normality in an otherwise alien environment.

5.3.3 Length of stay

Although the experience of chest pain is usually anxiety-provoking, patients expressed a desire to return home as soon as possible. The exception was when symptoms continued, and the patient felt safer being monitored. Otherwise, once symptoms had subsided, and/or a diagnosis had been given, most respondents were eager to continue with normal life and its responsibilities. Acceptability of length of stay and, in particular, waiting times has been discussed previously as being a complex issue. It is bound up with overall experience satisfaction, and the psychology of different waiting experiences (Nairn et al., 2004). The findings from this study highlight these complexities. Patients were concerned about using up precious NHS resources if they remained in hospital. Although one aim of the CPU is to reduce admissions, and intensive testing aims to provide more diagnostic certainty and therefore a speedier discharge, offering an exercise test the next day in one site meant an unexpected overnight stay. In another site, patients could negotiate to return next day, thereby avoiding an admission. Another source of extended stay was delay in discharge. This was usually brought about by having to wait for a doctor to make a final discharge decision. As already discussed, this delay may be reduced where nurses have the autonomy to discharge patients. Patients also often had to wait for medication prior to discharge. Delays in discharge led to frustration, particularly if patients and their relatives were not clear about the expected time of discharge. Although patients generally preferred to remain in hospital for a short length of time, there was also the risk of feeling ‘rushed in and out’, with little time provided for discussion of the patient’s diagnosis and aftercare. These findings show that overall length of stay may be less important for patients than appropriate use of time and communication skills by professionals.

5.3.4 Information

One finding of this study is that the amount and type of information-giving is not always perceived by patients as optimal. This is supported in a patient-satisfaction study by Taylor and Benger (2004), as well as in the quantitative results from this trial. The qualitative study adds to these findings by highlighting the specific aspects of information-giving that were found lacking. Respondents from two sites in particular felt that they did not adequately understand the rationale and implications of their investigations. Respondents from these two sites also recalled less interaction with a specialist nurse. It is acknowledged that in a small sample this association is only an indication. Other possible explanations are that information, when available, may not have been
The ESCAPE trial of chest pain units

adequately absorbed by some patients during attendance. Many patients are less able to deal with information at the point that it is being given due to anxiety, fear, tiredness or low consciousness levels. Gaps in knowledge tended to become more apparent following discharge, when patients had time to reflect upon their experiences, and discuss future implications with their GP, family and friends. Price et al. (2005) modified the information-giving process at a rapid-access chest pain clinic to include a thorough explanation of diagnosis-specific information, following similar findings in terms of limited patient understanding. They did not, however, discuss the need for information following discharge home. Our study shows the need to assess patient understanding prior to discharge. In addition, access to a help-line may be useful after returning home. This would ensure that individual informational needs are met with appropriate timing, clarification and reinforcement.

5.3.5 Diagnosis and aftercare

Differences between the CPU protocol and usual care meant that, at interview, the CPU patients who required an exercise test had undergone the test, whereas those from the control sites had not. Consequently, some patients from control sites are not fully reassured of their diagnosis at the time of discharge. This can be frustrating as patients feel the need to know how to proceed in terms of health-related behaviours and recurring symptoms. However, for patients who have had an exercise test but no definite diagnosis, there may be increased anxiety as there is no further link with the hospital. Without the ability to name the source of discomfort, patients lack the power to relieve it, or to decide how seriously to take it, and this can affect an individual’s global view of their own health (Good, 1994). In three of the five cases where no pathology could be identified at all from clinical investigations (often referred to as atypical chest pain), there was concern about an underlying cause that might recur in the future. Attending to the psychological needs of the ‘worried well’ (McDonald et al., 1996; Esler and Bock, 2004) may therefore avoid potential anxiety and repeated health care attendances.

In addition, referrals and self-care advice were limited to the minority of patients with a cardiac diagnosis. Individuals with no cardiac diagnosis rarely received information from the emergency department. This may be due to an emphasis on the cardiac specialism of the professionals involved in care (Agard et al., 2005). Participants whose diagnosis was gastric- or muscle-related typically sought further advice from their GP, and/or a non-NHS practitioner, such as a counsellor or osteopath. It was assumed that a recurrence would result in re-use of similar services, and because there was a high degree of satisfaction, no respondents from any site reported reservations about returning in terms of quality of care. However, the findings from our study also add that future health care-seeking behaviour may differ with diagnosis. Those patients with a diagnosis of angina were most clear about the importance of re-using the service, including emergency services. There was concern raised where the unit was some distance from home, for example when a smaller local hospital unit had been closed. Anxiety was based on the length of time taken to travel to a larger hospital, even by ambulance. From the responses it would appear that patients with a specific but non-cardiac diagnosis might be less likely to return
The ESCAPE trial of chest pain units

with similar symptoms because they felt reassured that their problem was not life threatening. Those experiencing panic attack or palpitations were more ambiguous about future health care seeking. For these respondents, the fear of ridicule and embarrassment was an issue. However, patients attending with panic attack were reassured appropriately by staff in the participating units, and their fears were alleviated. Sensitivity to psychological barriers, potential referral for treatment (Mayou, 1998) and advice from staff may therefore be key factors in ensuring that these patients seek help appropriately.

Patients reflecting upon their chest pain care experiences after discharge often made decisions to change their lifestyle in order to avoid further problems. This is a common occurrence for individuals who have experienced a myocardial infarction (Weinman et al., 2000). Although difficult to achieve, a number of patients in our study had made health-enhancing decisions to cut down or stop smoking, or change their diet. Others were making attempts to streamline their lifestyle or spend more time relaxing. As Weinman et al. (2000) have shown, reducing activity is often chosen because of the attribution of CHD to stress. This choice may be counterproductive, as lower activity levels reduce overall fitness. It is therefore important that patients receive appropriate messages about how to improve their well-being beyond discharge.

5.3.6 Strengths and weaknesses

The method of semi-structured interviews has allowed participants to describe care experiences in their own words, thereby accessing any issues not covered in the quantitative part of the trial. Patient accounts may also provide details that questionnaire responses cannot provide. The method also allows the context of living and dealing with chest pain to be examined, providing information from the whole pathway.

Although the response rate was lower than expected, we consider that the information obtained reached ‘saturation’; that is, no new data were being produced in the final interviews. Telephone interviews were not taken up as keenly as we would have liked, and this may be due to requesting an additional task in that patients return a consent form to the researcher.

The methodology does not seek to demonstrate statistical differences between intervention and control sites. In addition, only half the available sites were accessed in order to carry out the interviews. However, the 26 accounts showed variation in terms of site, diagnosis, time of arrival, and other factors. These qualitative data focus on issues that patients found important in terms of their chest pain experiences and care.

5.3.7 Implications for practice and research

Analysis of patient accounts from this study has identified specific areas of practice that might enhance experience and well-being for the patient attending with chest pain. These include:

- increased patient understanding of how to deal with chest pain when it occurs;
- continuity of specialist care on attendance;
**The ESCAPE trial of chest pain units**

- optimisation of specialist nurse roles in terms of autonomy to impact on care and organisation (e.g. discharge responsibility);
- attention to individual information needs;
- opportunity for discussion of diagnosis, implications and self-care with specialist prior to discharge;
- referral to non-cardiac specialist if necessary;
- access to appropriate information and advice after discharge;
- support in making relevant changes to lifestyle.

Areas of potential further research might include:

- detailed assessment of chest pain patient needs in terms of required information and aftercare, stratified by diagnosis;
- evaluation of specialist cardiac nurse availability and roles and the effects of these upon patient care and satisfaction;
- qualitative exploration of individuals’ experiences of panic attack.

## 5.4 Conclusions

The chest pain care experience as a whole was mainly described as an unfortunate interruption to normal life. Throughout this experience, patients attempt to cope and/or make sense of what is happening. The emergency department or CPU represents part of this pathway, and, as such, experiences here have the potential to influence patient understanding, emotional reactions and behaviour during attendance and beyond discharge. Although patient satisfaction is high, some aspects of care and diagnosis may not be understood or remembered following the ordeal of an emergency attendance. In addition, the nature of emergency medicine, with its emphasis on acute conditions and speed of care delivery, may tend to overlook patient needs following recovery, resulting in inappropriate use or non-use of services.

Access to timely and appropriate reassurances and information both during and after attendance might therefore enable patients to choose health-enhancing behaviours in the future. The role and autonomy of the cardiac nurse appears particularly important in providing patients with satisfactory care, and the opportunity to identify and discuss individual needs.
6.1 Effectiveness

The following estimates were obtained for parameters used to populate the model.

1. The proportion of chest pain patients who had ST-elevation myocardial infarction varied across the trial hospitals from 1.6 to 7.8% with an overall mean value of 3.6% (95% CI, 3.5–3.7%).

2. Expected mortality from ST-elevation myocardial infarction was estimated from trial onset-to-needle data using the Boersma equation. Overall, expected mortality ranged from 4.05 to 21.75%, with a mean of 10.04% and median of 10.08%. Mean expected mortality was 10.03% (95% CI, 9.96–10.10%) among patients who attended when no CPU was available.

3. The estimated effect of CPU availability upon expected mortality from ST-elevation myocardial infarction was a non-significant increase of 0.07% (95% CI, −0.18 to 0.33; \( p=0.568, \rho=0.0210 \)).

4. The proportion of chest pain patients subsequently discharged with ACS at a hospital with no CPU was estimated to be 1.2% (95% CI, 0.6–2.3%) using data from Collinson et al. (2000).

5. The effect of CPU availability upon discharge with ACS was estimated by converting the odds ratio for the adjusted effect of CPU availability upon (re-)admission of an initially discharged patient to a relative risk, assuming a 1.2% control risk. Trial data showed that 983 of the 78,270 patients who attended with chest pain (1.3%) were re-admitted with a complaint that could have been related to chest pain after being discharged at initial attendance. The proportion of such cases at CPU hospitals was 1.2% (213/17,789) before intervention and 1.3% after (261/20,546), while at control hospitals it was 1.3% (259/19,530) before and 1.2% after (250/20,405). The odds ratio for the adjusted effect of CPU care was 1.26 (95% CI, 0.92–1.72; \( p=0.146, \rho=0.008 \)), giving a relative risk of 1.256 (95% CI, 0.921–1.705).

6. The effect of inadvertent discharge upon ACS mortality, compared with admission, was estimated to be a 3% absolute increase using data from a literature review outlined in our previous model (Goodacre and Calvert, 2003).

7. The mean area under the curve for health utility up to 6 months after attending a hospital with no CPU available was estimated to be 0.318 QALYs (95% CI, 0.311–0.326 QALYs) using trial data from patients attending CPU hospitals before intervention and attending a control hospital at any time.

8. The estimated effect of CPU upon mean area under the curve for health utility up to 6 months was a non-significant improvement of 0.0084 (95% CI, −0.0168 to 0.0337; \( p=0.512, \rho=0.0064 \)).
Discounted quality-adjusted life expectancy (after the initial 6 months) for patients with CHD was estimated to be 6.83 QALYs.

6.2 Resource use

Resource use was estimated from the 1- and 6-month patient questionnaires, with the exception of length of stay at initial attendance, which was collected by hospital record review of all patients who were selected for questionnaire mailing. Details of response rates to the questionnaires are outlined in Section 4. Table 28 compares resource use at CPU and control hospitals and estimates the effect of CPU care upon resource use at 1 and 6 months, compared to control hospitals and adjusted for age, gender and pre-intervention differences between CPU and control hospitals.

<table>
<thead>
<tr>
<th>Table 28 Resource use at CPU and control hospitals</th>
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<tbody>
<tr>
<td><strong>Question</strong></td>
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<tr>
<td>Telephone health advice</td>
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<tr>
<td>1 month</td>
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<tr>
<td>210/585 (35.9%)</td>
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<tr>
<td>6.222 Resource use</td>
</tr>
<tr>
<td>Resource use was estimated from the 1D and 6D month patient questionnaires, with the exception of length of stay at initial attendance, which was collected by hospital record review of all patients who were selected for questionnaire mailing. Details of response rates to the questionnaires are outlined in Section 4. Table 28 compares resource use at CPU and control hospitals and estimates the effect of CPU care upon resource use at 1 and 6 months, compared to control hospitals and adjusted for age, gender and pre-intervention differences between CPU and control hospitals.</td>
</tr>
<tr>
<td>GP surgery visits</td>
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<tr>
<td>1 month</td>
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<tr>
<td>421/605 (69.6%)</td>
</tr>
<tr>
<td>6.222 GP surgery visits</td>
</tr>
<tr>
<td>315/517 (60.9%)</td>
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<tr>
<td>GP home visits</td>
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<tr>
<td>1 month</td>
</tr>
<tr>
<td>66/580 (11.4%)</td>
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<tr>
<td>6.222 GP home visits</td>
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<tr>
<td>44/506 (8.7%)</td>
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<tr>
<td>Nurse home visits</td>
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<tr>
<td>1 month</td>
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<tr>
<td>56/580 (9.7%)</td>
</tr>
<tr>
<td>6.222 Nurse home visits</td>
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<tr>
<td>30/507 (5.9%)</td>
</tr>
<tr>
<td>Social worker visits</td>
</tr>
<tr>
<td>1 month</td>
</tr>
<tr>
<td>37/577 (6.4%)</td>
</tr>
<tr>
<td>6.222 Social worker visits</td>
</tr>
<tr>
<td>25/505 (5.0%)</td>
</tr>
<tr>
<td>Emergency department</td>
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<tr>
<td>1 month</td>
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<td>237/589 (40.2%)</td>
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</table>
The ESCAPE trial of chest pain units

<table>
<thead>
<tr>
<th>Time taken off work</th>
<th>6 month</th>
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<tbody>
<tr>
<td></td>
<td>53/510</td>
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<tr>
<td></td>
<td>(10.4%)</td>
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<tr>
<td>Time taken off work</td>
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<td>148/623</td>
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<td></td>
<td>(23.8%)</td>
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<tr>
<td>Time taken off work</td>
<td>6 month</td>
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<td></td>
<td>53/510</td>
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<td></td>
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<tr>
<td>Operations or procedures</td>
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<tr>
<td></td>
<td>33/514</td>
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<td></td>
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<tr>
<td>Diagnostic tests</td>
<td>6 month</td>
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<tr>
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<td>108/519</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Diagnostic tests</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td>226/628</td>
</tr>
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<td>(36.0%)</td>
</tr>
<tr>
<td>Diagnostic tests</td>
<td>6 month</td>
</tr>
<tr>
<td></td>
<td>180/522</td>
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<tr>
<td>Hospital admissions</td>
<td>6 month</td>
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<tr>
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<td>64/518</td>
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<td>(12.4%)</td>
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<tr>
<td>Hospital admissions</td>
<td>1 month</td>
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<tr>
<td></td>
<td>216/636</td>
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<tr>
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<td>(34.0%)</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>6 month</td>
</tr>
<tr>
<td></td>
<td>172/524</td>
</tr>
<tr>
<td></td>
<td>(32.8%)</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>6 month</td>
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<tr>
<td></td>
<td>180/522</td>
</tr>
<tr>
<td></td>
<td>(34.5%)</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>1 month</td>
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<tr>
<td></td>
<td>266/595</td>
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<tr>
<td></td>
<td>(44.7%)</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>6 month</td>
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<tr>
<td></td>
<td>200/512</td>
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<tr>
<td></td>
<td>(39.1%)</td>
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<tr>
<td>Procedures</td>
<td>6 month</td>
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<tr>
<td></td>
<td>62/388</td>
</tr>
<tr>
<td></td>
<td>(16.0%)</td>
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<tr>
<td>Procedures</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td>76/484</td>
</tr>
<tr>
<td></td>
<td>(19.7%)</td>
</tr>
<tr>
<td>Procedures</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td>62/388</td>
</tr>
<tr>
<td></td>
<td>(16.0%)</td>
</tr>
<tr>
<td>Time taken off work</td>
<td>6 month</td>
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<tr>
<td></td>
<td>53/510</td>
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<tr>
<td></td>
<td>(10.4%)</td>
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<tr>
<td>Time taken off work</td>
<td>1 month</td>
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<tr>
<td></td>
<td>148/623</td>
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<tr>
<td></td>
<td>(23.8%)</td>
</tr>
<tr>
<td>Time taken off work</td>
<td>6 month</td>
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<tr>
<td></td>
<td>53/510</td>
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<tr>
<td></td>
<td>(10.4%)</td>
</tr>
</tbody>
</table>

Patients generally used health service resources less in the post-intervention period, but there was no significant effect upon resource use associated with the introduction of CPU services. For most items of resources use there was a non-significant trend towards reduction associated with introduction of CPU care.

Length of stay was recorded for 5512/5584 patients (98.7%), ranging from zero to 128 days, with a mean of 2.5 days and median of 1.0 days. Mean length of stay was 2.72 days before and 2.79 days after intervention at the CPU hospitals, and 2.19 days before and 2.31 days after intervention at the control hospitals. The introduction of CPU care was associated with a non-significant 0.04-day decrease in length of stay (95% CI, −0.59 to 0.52; p=0.894, rho=0.0086).

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6.3 Direct CPU costs

A total of 1644 patients received the full CPU protocol and attracted remuneration of £106 each, giving a total of £174,264 provided to support CPU care across all seven hospitals. There were a total of 20,546 chest pain-related patient attendances at the CPU hospitals in the post-intervention year, giving an estimated additional cost of £8.48 (95% CI, £8.06–8.90) per patient with chest pain. These costs were added to the costs per patient up to 6 months after attendance of all patients who attended a CPU hospital in the post-intervention year and were sent a questionnaire.

6.4 Costs per patient

Costs per patient up to 6 months after initial attendance (excluding initial emergency department attendance) ranged from zero to £28,248, with a mean of £2385 and a median of £1566. Mean cost per patient was £2468 before and £2326 after intervention at the CPU hospitals, and was £2417 before and £2330 after intervention at the control hospitals. The mean cost per patient for all patients who attended a hospital with no CPU (i.e. all patients at control hospitals and pre-intervention patients at CPU hospitals) was £2405 (95% CI, £2280–2529). The introduction of CPU care was associated with a non-significant £31-per-patient reduction in costs (95% CI, −£400 to 461; p=0.889, rho=0.0082).

6.5 Cost-effectiveness analysis

The values used to inform the model are shown in Table 29, along with the range used in probabilistic sensitivity analysis.

The model showed that CPU care was associated with a small increase in effectiveness of 0.0075 QALYs per patient, with substantial uncertainty around this estimate (95% CI, −0.0179 to 0.0322 QALYs), and a small decrease in costs of £32 per patient, also with substantial uncertainty (95% CI, −£399 to 467). This means that, although the baseline estimates suggest that CPU dominates routine care, there is substantial uncertainty around this conclusion. The 95% confidence interval for the incremental cost-effectiveness ratio ranges from CPU being dominant to routine care being dominant.
The ESCAPE trial of chest pain units

Table 29 Values used in the decision tree

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Moments of distribution</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Beta distribution</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Alpha (α)</strong></td>
<td><strong>Beta (β)</strong></td>
</tr>
<tr>
<td>PSTEMI</td>
<td>4799.26</td>
<td>128513.56</td>
</tr>
<tr>
<td>pACSdisc</td>
<td>7.55</td>
<td>621.82</td>
</tr>
<tr>
<td>Incmort</td>
<td>10.92</td>
<td>353.1</td>
</tr>
<tr>
<td></td>
<td><strong>Normal distribution</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td><strong>Standard error</strong></td>
</tr>
<tr>
<td>CpuSTEMI</td>
<td>0.0007</td>
<td>0.0013</td>
</tr>
<tr>
<td>CPUdisc</td>
<td>1.256</td>
<td>0.1962</td>
</tr>
<tr>
<td>RoutQALY</td>
<td>0.318</td>
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</tr>
<tr>
<td>CpuQALY</td>
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<td>0.0129</td>
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<td>LtQALY</td>
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</tr>
<tr>
<td>RoutCOST</td>
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<tr>
<td>CpuCOST</td>
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</tr>
<tr>
<td>LtCOST</td>
<td>£10,079</td>
<td>2211.1933</td>
</tr>
</tbody>
</table>

Figure 6 shows the cost-effectiveness plane for CPU compared to routine care. This is a plot of the results of the probabilistic sensitivity analysis (for 1000 bootstrap estimates) showing the difference in effectiveness (x axis) and costs (y axis) between CPU and routine care. Each point provides an estimate of whether CPU is cost-effective compared with routine care: 39.1% of the estimates lie in the south-east quadrant (CPU dominates routine care), 32.9% lie in the north-east quadrant (CPU more effective but more expensive), 16.2% lie in the south-west quadrant (CPU cheaper but less effective) and 11.8% lie in the north-west quadrant (routine care dominates). This confirms the substantial uncertainty, with non-negligible probabilities for all four interpretations of cost-effectiveness.
Figure 7 shows the cost-effectiveness acceptability curve for CPU compared with routine care. This shows the probability that CPU will be considered cost-effective plotted against the threshold for willingness to pay per QALY gained (lambda), ranging from zero to £100,000 per QALY. This shows that in our analysis willingness to pay for health gain does not appear to be an important factor in determining CPU cost-effectiveness. If we are not prepared to pay anything to gain additional QALYs, CPU care is still slightly more likely to be cost-effective than routine care (about 56%). If we are willing to pay for health gain then the probability that CPU care will be considered cost-effective rises slightly. Regardless of the amount we are willing to pay the probability that CPU will be cost-effective remains around 72%.
Limitations of the economic analysis

This economic analysis has an important limitation that needs to be taken into account in interpreting the findings. The comparison of the costs and effects of CPU compared with routine care is made on a per-patient basis, which assumes that CPU and routine care will be applied to the same population of patients attending hospital. In other words, it assumes that the decision to implement CPU care or continue with routine care does not influence the size or characteristics of the population requiring the services. However, the quantitative study found some weak evidence that the implementation of CPU care was associated with increased attendances with chest pain and increased medical admissions. If introducing CPU care leads to increased attendances with chest pain then the assumptions in this analysis will not hold. Furthermore, whereas it is clear that additional attendances will incur health service costs, we do not have any evidence that they will gain benefit from their attendance.

Thus we have some evidence, which cannot be incorporated in the economic model, that introducing CPU care will increase health service costs without any corresponding evidence that it will improve outcomes. In these circumstances it is difficult to claim that CPU is likely to be cost-effective, especially considering the substantial uncertainty surrounding the results on the economic analysis.
The ESCAPE trial of chest pain units

6.7 Summary

- The economic analysis showed that CPU is slightly more effective and less expensive than routine care, although both of these estimates are surrounded by substantial uncertainty.
- Although there is a 39% probability that CPU care is cheaper and more effective than routine care, there is a 12% probability that the converse is true.
- If the introduction of CPU care leads to increased attendances with chest pain then the assumptions used in the model do not hold.
The ESCAPE trial of chest pain units

Section 7 Organisational evaluation of CPU implementation

7.1 Aim

It became apparent during the study that the process of CPU implementation and the activity of the individual CPUs varied substantially between hospitals. This variation was not adequately explained by simple structural differences between hospitals, such as their size or geographical location, or between CPUs, such as staffing and opening hours. We therefore planned an additional investigation that aimed to determine how organisational factors influenced the development of CPU care.

7.2 Method

The organisational study was undertaken independently of the main research project by two researchers (MM and AC) who were not involved in other aspects of the study. A multiple case-study approach was taken, treating each site as a ‘case’ (Yin et al., 2003). Six of the seven intervention sites were studied. The decision to look at six sites was based on time and resource availability. In the initial planning for this part of the study it had been proposed that we should look at three control and three intervention sites, it was subsequently decided that it would be of greater value to explore more of the intervention sites. The six sites were chosen partly because of geographical location, with one distant CPU hospital (L) being excluded.

7.2.1 Sample

Sites A, D, E, G, J and N were investigated. The core personnel involved in CPU care at the intervention sites were emergency department medical staff, cardiologists and the nurses staffing the CPU. All lead consultant cardiologists and emergency consultants for the trial and all CPU nurses were approached, initially through the ESCAPE trial lead for each site, and invited to participate.

The final sample of 26 participants across all six target sites comprised the following staff: consultant cardiologists \((n=4)\), emergency consultants \((n=6)\), and nurses \((n=16)\). The trial medical lead and the lead CPU nurse for each site were represented in the final sample.

In addition the Clinical Manager (JA) for the trial was interviewed following data collection at the sites. The Clinical Manager had been active in supporting the development of CPU care at the intervention sites and it was felt that she would have valuable insights that could be used to compare and contrast with the data from the intervention sites.
The ESCAPE trial of chest pain units

7.2.2 Data collection

Qualitative data were collected from all participants through semi-structured interviews. The interviews were carried out by one researcher (MM) with a health service background, and conducted between January and August 2006 following the completion of the trial year at each site. Interviews were carried out on the hospital site at the convenience of the participants and lasted between 40 and 70 minutes per interview. Most of the interviews were with individual participants, although two interviews were carried out with two participants and two interviews with three participants at one time. Group interviews may yield different data than individual interviews; relationships between the respondents may either limit or facilitate open and frank comment and this was considered during data analysis. The interview schedule was led by the aims of the study and informed by existing literature. Participants were asked to reflect on their experience of the trial including perceptions of strengths and weaknesses of the prior and current service and challenges for the future. Specific issues explored were managing change, leadership, decision-making and role boundaries. Additional insights that informed the analysis came from observations made during interviews and visits to the sites. Brief field notes were made immediately following visits for interviews and included observations where possible on informal interpersonal communication between staff and on the geographical layout of the relevant departments, particularly the observation area for CPU care.

Questionnaire data were collected from the chest pain nurse teams via a questionnaire comprising of the Team Climate Inventory (Anderson et al., 1998) and questions about qualifications and years of experience in the role. The questionnaire was posted to the lead chest pain nurse at each site who distributed them to the CPU team. Some 18 questionnaires were distributed and nine were returned. Questionnaires were coded for site before distribution and were completed anonymously.

7.2.3 Data analysis

The interviews from the six sites were transcribed verbatim, identifying words and phrases were omitted, the transcripts coded for site and category of participant, and then entered into NVIVO qualitative data-analysis software. Identifying information was stored separately. Template analysis (King, 2004), a flexible technique for organising and analysing textual data, was used to organise and code the data into themes and sub-themes. Following an initial familiarising stage during which the transcripts were read and the interview tapes listened to, a coding template was developed using an input, process and output structure. This is a commonly used structure for understanding the relationships between factors affecting team effectiveness. The template continued to evolve through a number of stages during the coding process. Relationships between and within individual cases and cases grouped by level of CPU activity, and between and within categories of respondents, were explored in the analysis to reveal similarities and differences. Once an initial analysis had been carried out findings were compared with the data from the Clinical Manager for the ESCAPE trial to look for areas of agreement and disagreement with the findings. There was a high level of congruence between the findings from the
The ESCAPE trial of chest pain units

data analysis and the insights from the Clinical Manager data. The analysis was carried out by one researcher (M.M.) and supervised by a second researcher (A.C.) experienced in organisational research and not otherwise connected to the trial.

Questionnaire responses were received from between one and three chest pain nurses at four of the six sites. These data are therefore of limited value and no meaningful analysis of the Team Climate Inventory is possible without responses from most members of most teams. The data on qualifications and experience are presented in Table 30.

Table 30 Qualifications and experience of chest pain nurse respondents

<table>
<thead>
<tr>
<th>Site</th>
<th>Response</th>
<th>Qualifications</th>
<th>Experience</th>
<th>Part time/full time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1</td>
<td></td>
<td>RGN, Coronary Care Course, ALS instructor</td>
<td>4 years chest pain nurse</td>
<td>Full-time</td>
</tr>
<tr>
<td>D  0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 3</td>
<td></td>
<td>1. RGN</td>
<td>1. 10 years CCU, 11 months CPU</td>
<td>1. Part time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. RGN, Coronary Care Course</td>
<td>2. 5 years cardiology</td>
<td>2. Full time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. RGN</td>
<td>3. 1 year CPU</td>
<td>3. Full time</td>
</tr>
<tr>
<td>G 3</td>
<td></td>
<td>1. RGN, Critical Care Diploma</td>
<td>1. 15 months chest pain nurse</td>
<td>1. Part time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. RGN</td>
<td>2. 4 months CPU</td>
<td>2. Part time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. RGN, Coronary Care Course</td>
<td>3. 2.5 years cardiology</td>
<td>3. Part time</td>
</tr>
<tr>
<td>J 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N 2</td>
<td></td>
<td>1. RGN, BSc, Coronary Care Course, Nurse Prescribing Course</td>
<td>1. 5 years cardiology</td>
<td>1. Full time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. RGN, Coronary Care Course</td>
<td>2. 5 years cardiology, 1 year CPU</td>
<td>2. Full time</td>
</tr>
</tbody>
</table>

CCU, coronary care unit.

7.2.4 Input-process-output model

An input-process-output model was used to provide a structure for analysis of the qualitative data (Table 31). The development of the CPU for the ESCAPE trial had many characteristics of team-based activity with a reasonably delineated group involved in establishing the service in each site. Input-process-output models have been developed as descriptive frameworks for understanding and predicting group or team effectiveness (McGrath, 1964) and provide a useful structure for understanding the relationships between complex factors affecting team performance. Borrill et al. (2000) used an input-process-output structure.
The ESCAPE trial of chest pain units

as a theoretical framework in a recent major review of effective health care teams and the current study is to some extent influenced by the categories in their model. An important aspect of this model is the notion of feedback loops between outputs and inputs and outputs and processes, and the suggestion that inputs may directly affect outputs. For example, in the data presented here it is easy to imagine a team-member characteristic such as personality type having a direct impact on cooperative behaviours as an output, or that perceived effectiveness as an output would effect the process of service delivery.

### Table 31 Main themes of the organisational analysis

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Process</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational readiness</td>
<td>Leadership</td>
<td>Effectiveness</td>
</tr>
<tr>
<td>Team characteristics</td>
<td>Continuity of staffing</td>
<td>Team-member impact</td>
</tr>
<tr>
<td>Role boundaries</td>
<td>Delivering the service</td>
<td>Cooperative behaviours</td>
</tr>
<tr>
<td>Expectations</td>
<td>Overcoming boundaries</td>
<td>Role</td>
</tr>
<tr>
<td></td>
<td>Role autonomy</td>
<td>clarification/expansion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visibility</td>
</tr>
</tbody>
</table>

7.3 Findings

Relationships between the data and the level of CPU activity across the six sites are highlighted when appropriate and sites are referred to as high-, medium- or low- (patient-) throughput sites. This label of low, medium and high activity is simply made on the basis of the number of CPU patients per site during the trial year and does not imply any judgement of quality or effectiveness of the service nor make assumptions about the input of time or effort.

The data are presented under thematic headings with similarities and differences between and within cases highlighted. The main themes that emerged are seen in Table 31 and are described under the input-process-outputs structure.

7.3.1 Inputs

Organisational readiness

It was apparent from the interviews that the sites were at different stages of readiness to take on this project, but all expressed a recognition that the management of acute chest pain generally, and low-risk chest pain particularly, was something that needed to be addressed and saw this as an ideal opportunity to meet an as-yet-unmet need.

…we were aware that most of our chest pains were being admitted even though many of them didn't need to be admitted and we needed to come up with a system like they already had in Sheffield to screen and rule in or out in A&E depending on their risk, but we didn't have any money.

(Emergency consultant, medium-throughput site)

This quote is typical and suggests the notion of an ‘opportunity in waiting’ that was reflected across most of the sites.
The ESCAPE trial of chest pain units

...we'd been thinking about this sort of thing long before the ESCAPE trial was conceived, in fact with colleagues here we were thinking along those lines; in fact for a couple of years beforehand, it didn't quite come to fruition, but we were working our way along that way.

(Cardiology consultant, high-throughput site)

This is unsurprising as each of these sites had volunteered to take part in the trial, which perhaps suggests an existing interest in this as area for development. However, although all sites reported this unmet need the data suggest differences in the extent to which the ground was primed for this innovation prior to the trial. Factors such as existing relationships, the reported attitudes to and history of change, and the nature of the existing service were salient. Of these the quality and extent of the relationship between key personnel, particularly between cardiology and the emergency department, seems particularly important, illustrated by the two contrasting examples here from high- and low-activity sites.

The relationship with cardiology is very good; we're practically handcuffed to them. It's very positive, it works very well, there's no stress on that relationship, that's all very positive.

(Emergency consultant, high-throughput site)

By contrast, in response to a question about the relationship between emergency medicine and cardiology services the data suggest that at this site the two specialities have not had a strong history of collaboration.

I wouldn’t say it’s very close. No, it’s not a close relationship, not at all. No, cardiology tend to keep themselves to one side and as does A&E don’t they? There isn’t a lot of overlap between the two at all.

(Chest pain nurse, low-throughput site)

Where positive relationships were reported these seemed to be associated with working arrangements already in place that promoted and maintained these relationships such as interdepartmental meetings or a history of joint projects.

...thrombolysis has a very high profile as far as the Trust’s audit and star ratings...so we have monthly meetings to review things and (the chest pain nurse) is involved in that...and those meetings are held in A&E with A&E staff and cardiology staff and ECG staff all getting together so there’s automatically a team built up, and people know one another....

(Cardiology consultant, high-throughput site)

It was also clear that there were important informal relationships in three of the four medium- and high-activity sites, as shown by talk of shared experiences not connected with work such as children going to the same school, a relaxed and comfortable banter between colleagues from the same site, and humorous comments made about each other during separate interviews. The presence of such relationships may well have been important during negotiations around the setting up of the service and in dealing with potential conflicts.

All that is often needed is a bit of an informal chat. I have found generally that it’s better to be friends with people, if you’re on good terms with people it’s difficult for them to be unreasonable.

(Consultant cardiologist, high-throughput site)
**The ESCAPE trial of chest pain units**

**Change history**

There was a view of how change is managed and supported and of the local history of innovation with opinions being expressed on attitudes to change amongst staff in the relevant departments. Most respondents talked of the challenges that change can bring, and there was a common view that much depended on the personal characteristics of those involved. Whereas most respondents talked in general terms about the difficulties of staff resistance to change in the NHS there were differences in how sites reflected on the prevalent attitudes in their own settings and the data suggest that these may have been more negative in sites with lower CPU activity.

*Change isn’t managed well, certainly not in this department….*

**Interviewer:** Why do you think that is…?

*Staff resistance is a big issue. Across the board I think isn’t it really, probably more so with the more senior ones and those that have been here a longer period of time. Don’t see that as my job sort of thing; you know, you’re here to do that or whoever, so yes it’s staff resistance.*

(Chest pain nurse, low-throughput site)

*I think it’s quite polarised between the ones who see change as being potentially useful and those who actually don’t want to change because they’re comfortable where they are. There’s this relative inertia in (some) staff to change things. They don’t want to change things and it’s one of the difficult things to overcome really.*

(Emergency consultant, low-throughput site)

Where a positive experience of change was reported this tended to be associated with the quality of the existing relationships, particularly the informal interpersonal communication discussed in the previous section.

*There will always be areas that are relatively delicate because they are dear to the heart of one or other of the people involved but generally we are able to talk to each other pretty well, on a personal level people get on well so when it comes down to business, like if there is a referral or a clinical decision then there is a good relationship, you know there will always be some degree of friction…but I wouldn’t say that there are any entrenched ideas.*

(Cardiology consultant, high-throughput site)

Respondents from both of the high-activity sites felt that their departments were responsive to change and were keen to cite examples to support this assertion.

*A group of us went to a kind of new advances in medicine meeting last year, and out of all the stuff they were putting forward as being new and innovative I think everything but one area we were already well advanced with that. I think we’re innovative and cooperative and reasonably good at communicating.*

(Emergency consultant, high-throughput site)

**Existing service and personnel**

Prior to the start of the trial there were differences in the characteristics of the chest pain services, particularly the number and role of chest pain nurses. For example, site D had a well-established team of five chest pain nurse practitioners working in the emergency department for some time and a dedicated chest pain assessment ward and site A had two established chest pain
**The ESCAPE trial of chest pain units**

nurses. For others specific recruitment of staff was required to be able to deliver
the CPU service.

*There had been until 2002 a thrombolysis nurse who left and recruitment of a
suitable replacement was notable by its lack of success...so we had a CCU
[coronary care unit] nurse seconded into that role at the same time as the start of
the ESCAPE trial.*

(Cardiology consultant, medium-throughput site)

Whereas all sites had experienced nurses in the role for the duration of the trial,
for some this meant transferring this expertise to the emergency department
and establishing new working relationships. This issue will be returned to under
the role boundaries theme (see below).

**Team characteristics**

The idea that this intervention requires the involvement of a team that crossed
departmental, professional and speciality boundaries from the start was one that
was shared by at least some staff in all sites. Respondents talked in terms of it
needing to be a ‘team effort’ or that ‘it relies on the multi-disciplinary team’.
However, it was also clear from the data that there were differences in the
boundaries of the team and the extent to which the key players saw themselves
as engaging as a team. Potential core members of the team involved in the CPU
service as part of the ESCAPE trial included a cardiology and an emergency
consultant lead and the chest pain nurses, with an extended team including the
laboratory staff and ECG technicians, service managers and ward and emergency
department-based nursing staff. In some sites there was clear and active
participation from at least each of the three core groups, in others one or other
of these three groups was less involved.

*I think I facilitated (the ESCAPE trial) coming here in the first place...but then once
the decision was taken to go ahead with it then I had remarkably little to do with
it except providing the A&E side of the data.*

(Emergency consultant, medium-throughput site)

The ‘multi-disciplinary team’ was at least mentioned by most respondents, but
when asked directly what they considered the team to be there were differences,
particularly between the medical and nursing staff. Generally the medical staff
reported that the service was certainly a team effort that involved doctors,
nurses and other health professionals. Nurses, however, tended to articulate a
view of the ‘team’ as the two or more chest pain nurses with medical staff in a
supporting role.

*(The cardiologist) is very keen that there is a chest pain team and we are it, he
refers to us as ‘the team’, we are the team and then behind us are the cardiology
registrars...and behind them is him.*

(Chest pain nurse, medium-throughput site)

Although there was little evidence of the chest pain team becoming integrated
into the wider emergency department team in which most of them work, in the
high-activity sites the data suggest a blurring of the boundaries to some extent
and a very close working relationship with the emergency department staff while
still retaining a very clear and separate identity within the service.

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The ESCAPE trial of chest pain units

We still see ourselves as cardiology, but working within A&E...but we get support from a lot of the A&E staff...a lot are very supportive of the role.

(Chest pain nurse, high-throughput site)

By contrast in one of the low-throughput sites the chest pain nurses felt isolated as a team and very separate from the emergency department within which they work.

We’re stuck on the outskirts, in a sense, waiting for them to beckon us in sort of thing when the need arises.

(Chest pain nurse, low-throughput site)

This isolation was not necessarily accompanied by hostility or tension between the chest pain nurses and the emergency department staff as was reported in some sites, rather there was simply a sense of fragmentation and very fixed lines of demarcation; this is your work this is my work.

Experience and expertise

The chest pain nurses were from a cardiology or coronary care setting in all but one site. This is the usual background for nurses engaged in acute chest pain services, for example ‘thrombolysis nurses’, and such staff would be expected to have an appropriate range of skills and experience, such as ECG interpretation. However, there was a view expressed that this skill and experience is not sufficient and needs to be accompanied by additional qualities.

...you can’t just take a coronary care nurse and put them into this kind of role though. Whilst the background is important you need to add skills to that experience that they won’t necessarily have because they are working in quite a different environment in an A&E department.

(Cardiology consultant, high-throughput site)

...if the chest pain nurses were...the wrong type of person, if we had a typical CCU nurse we couldn’t have got past the first month.

(Emergency consultant, medium-throughput site)

This respondent talked of the importance of having the right person in the chest pain nurse role and of a willingness to intervene to ensure that this happened.

Enthusiasm

An important factor in influencing the level of activity of the CPU seems to be the enthusiasm and commitment of the chest pain nurse. This was particularly so in those sites that were establishing a new service rather than building on an existing service. This raises an important question about how much the development of a successful service relies upon the personal commitment of a key individual or individuals.

(The chest pain nurse) is the engine, and if you took him out of it, if he’s absent, there are people to do that role, and that works okay, but I think he does a lot more than just seeing the patients, and I think he’d be very hard to replace. But, I mean, as long as you had someone to replace him who had a similar drive and commitment, that would be fine, but I wouldn’t underestimate his importance; it works as well as it does because of him.

(Emergency consultant, high-throughput site)
The ESCAPE trial of chest pain units

Where this drive and enthusiasm is present there may be a danger of over-reliance on an individual who may not be able to sustain high levels of commitment without cost.

Yesterday I was supposed to work 8 until 4 and I was here until 7.30pm. We try to get a little of the time back. But we are exploited, it’s our Achilles heel....

(Chest pain nurse, medium-throughput site)

Role boundaries

It is clear that significant role boundaries have existed between the CPU nurses and emergency department staff, between CPU nurses and clinical investigations (ECG) staff, and to some extent between CPU and junior medical staff. It is not clear whether these were anticipated during the setting up of the CPU care or whether they were first revealed as the trial progressed. These boundaries were reported to some extent by all sites although at site D, where a 24-hours-a-day chest pain nurse role was well established, these boundaries and the difficulties they caused for staff had, in the main, been resolved before the trial began.

When we first went down to A&E...it was quite intimidating and we did come across quite a lot of friction, but when we got established and proved our worth then that was fine, they miss us when we’re not there.

(Chest pain nurse, medium-throughput site)

In other sites prior expectations of role based on profession and speciality created tensions that were keenly felt.

Where there was resistance was at a local level with some of the A&E (medical) staff and the nursing staff who regarded these people as interlopers and weren’t giving them the clinical support.

(Emergency consultant, medium-throughput site)

One barrier is being accepted in A&E...a major barrier...it’s a power thing, they don’t want someone else going...don’t come in telling us what to do.

(Chest pain nurse, medium-throughput site)

The problem with clinical investigations was that, some of them, felt that it wasn’t a nurse’s job, we shouldn’t be doing that, they were the ones that should do it.

(Chest pain nurse, medium-throughput site)

Such tensions relating to role boundaries have been reported before in new or specialist roles (Read, 1999; Read et al., 2001) and may result from poor understanding by others or lack of clarity of the role, particularly where there is ambiguity over lines of responsibility.

...one of the areas where the protocol fell down was that you never knew quite who was referring to the nurses...often you’d get this conflict about who’s responsibility the patient is...the patient will think why am I being examined by two different people and it does create a problem.

(Emergency consultant, medium-throughput site)

Expectations

With the intention to develop CPU care there came some concerns about the knock-on effect that this may have on workload and resources in other parts of
**The ESCAPE trial of chest pain units**

the service. These concerns were for the most part felt to be unfounded by the CPU staff but nevertheless created a possible barrier to fully embracing the innovation.

*Well, cardiology was, I think initially when we spoke to them, they were initially very reluctant. They were reluctant because they thought that there was a protocol that will have an access to their fast-track clinics. So they were reluctant that probably that might add extra pressure.*

(Emergency consultant, low-throughput site)

*I think the major problem locally is the resource limitation in terms of staffing didn’t always make it easy. It’s difficult, it’s getting the perception right, the concept right...people perceive it’s a lot more work but it isn’t, that’s the problem...people think well we haven’t got enough staff, we can’t get it through, we’ve got so many people to see, we can’t put a patient up for the ESCAPE trial, we’re busy-busy-busy. And that’s fine but if you can grasp the concept, this actually reduces your workload.*

(Chest pain nurse, low-throughput site)

Some of these concerns, particularly in the emergency department, were related to the pressure of the 4-hour waiting-time target, which was a significant and highly publicised issue at the time of the trial.

### 7.3.2 Process

**Leadership**

There was a wide range of leadership activity with a range of styles and models being described. A simple but often-cited continuum of telling, selling, consulting and joining (Sadler, 1970) can be used to characterise leadership in the context of the degree of participation in decision-making by the workforce, from manager-centred at one end to subordinate-centred at the other. We can see examples from both ends of this spectrum here, but also examples of an absence of leadership behaviour. Interestingly the two sites with the highest levels of activity, as indicated by numbers of patients seen, cited examples that seem to place them at opposite ends of this continuum. For example, in one high-throughput site:

*We tend to make decisions in a very democratic way, we meet very regularly...I guess we’re strong on communication and strong on cooperation.*

(Emergency consultant, high-throughput site)

There was a strong sense of shared decision-making among this group, of a leadership position that mirrored the joining style. This style requires confidence and trust in the workforce and is reflective of empowering models of leader behaviour. At this site there was agreement that it was the chest pain nurse who led this service and this was acknowledged by the individual in question who used a range of strategies to solve problems which were strongly participative and used the range of staff and expertise available.

*The problem area is the Lab...(it) had the potential to escalate out of control (but) it was quite quickly resolved, by virtue of the fact that I just got the A&E consultant and the cardiologist involved in the conversation with the laboratory manager.*

(Chest pain nurse, high-throughput site)
The ESCAPE trial of chest pain units

The reported leadership style in another high-throughput site was more manager-centred with common agreement that the service was led by a strong and dominant leader.

*He’s a strong leader who is fiercely loyal to his department, highly respected, but he is slightly less in with the boys, but it’s a different job, and I have a lot of respect for him, he is formidable at getting what he wants.*

(Emergency consultant, high-throughput site)

*There is no doubt that he is the leader.*

Interviewer: And would that be recognised down in A&E?

*Oh yes, he’s well respected.*

(Chest pain nurse, high-throughput site)

It was suggested by the respondent that this approach or style was not only appropriate but required in certain circumstances if results were to be achieved.

*I think that at certain times direction and focus needs to take priority over democratic discussion if you are going to move things on, the need for that becomes greater with more vocal people, type A personalities.*

(Cardiology consultant, high-throughput site)

There were also examples of leaders physically crossing departmental boundaries to establish relationships and to facilitate a team approach, particularly in the more active sites.

*I think being involved in the discussions and the education that goes on down there is very important so that the A&E staff buy into your vision because if they don’t buy into your vision then it’s going to be difficult for them to accept it so that’s something for cardiologists is if you want to develop something in A&E you have to get down to A&E in order to win hearts and minds.*

(Cardiology consultant, medium-throughput site)

Such ‘boundary-spanning’ leadership activity is likely to have contributed to establishing the intervention as an accepted and integrated part of the service.

Where leadership was missing this was noticed and seen as a lack of support.

*We didn’t get an awful lot of support, well we got no support I have to say from Cardiology, whatsoever, even though they was all for it and yes you will get the support...yes, and we got nothing.*

(Chest pain nurse, low-throughput site)

**Nurse autonomy**

The style of leadership may have some impact on the degree of autonomy in the role of the chest pain nurses delivering the service. It is recognised that greater autonomy for decision-making tends to emerge in the context of a more participatory, or joining, style of leadership. Whereas all respondents talked in terms of high levels of chest pain nurse autonomy there were differences in decision-making latitude that in some cases seemed to reflect the prevailing model of leadership. An example of this is differences in the restrictions on decision-making for discharge.
The ESCAPE trial of chest pain units

You needed a senior doctor, you needed a consultant to discharge the patient, and they were quite adamant about that even with the trial protocol they wanted a senior doctor to discharge.

(Chest pain nurse, high-throughput site)

Once the patients are referred to them they really take ownership of them, and they are extremely effective in terms of running them through the protocol, correlating the results, doing the discharge themselves….

(Emergency consultant, high-throughput site)

As avoiding admission and reducing bed occupancy are important outcomes for CPU care this may be influential. At the same site there was evidence that the autonomy of the chest pain nurse may not be clear and that strategies for influencing care reflected practices more associated with a traditional doctor/nurse relationship (Stein, 1967) and which are not congruent with recent ideas of autonomous practice.

The nurses are very autonomous, whilst they can’t actually prescribe say Amiodarone the junior doctor may well find it out on the drug card with a hint. We encourage the old-fashioned sister approach of saying ‘well how about doing…’ and if the junior doctor wants to ignore that then….

(Emergency consultant, high-throughput site)

Continuity of staffing

During the trial period there were a number of personnel changes that may have had an impact on the activity of the CPU. Two sites particularly experienced the loss of a key member of staff during the trial and also reported general difficulties with staffing in the emergency department. These were also the two sites out of the six studied that saw the fewest patients. In one site the trial lead left the hospital during the trial year which resulted in a new member of staff picking up this responsibility after the trial had begun.

It might have helped if (trial medical lead) had been aware of all the issues from the outset, because I think we was having problems before he came into it, and then it’s hard for him as a new consultant in a new department, new hospital, to try and take on these things.

(Chest pain nurse, low-throughput site)

In addition, more widespread staffing difficulties were reported.

At that time when this trial was started we didn’t have all our permanent staff with us, so we were basically running on the locums.

(Emergency consultant, low-throughput site)

Similar difficulties were reported at another site where a lead member of the team was away from the department for several months and where both medical continuity and retention of nursing staff was problematic.

...there’s a huge turnover of staff. I mean typically now our SHOs [senior house officers] change every 4 months, and then we’ve got another group of SHOs who change every 6 months, so we’re having some SHOs changing virtually every 2 months. And there’s a huge turnover in nursing staff as well, so it’s difficult to keep reminding them.

(Emergency consultant, low-throughput site)
The ESCAPE trial of chest pain units

Delivering the service

A number of operational issues had an effect on CPU activity in the sites. Interestingly the most obvious of these, the hours during which the CPU protocol could be delivered, does not appear to have had a clear impact on activity. Most sites operated during ‘office hours’ with only one site continuing the service overnight and at weekends (see Table 7). However this site required that patients were discharged by medical staff who were not fully engaged with the trial. This may have impacted on the throughput of patients and negated some of the benefits of having a 7-days-a-week, 24-hour service.

The most difficult issue…was with the junior doctors getting around to discharging patients quickly and I think we had big issues in getting people out at the point where they could have gone, I think if the junior doctors had complied then we could have cut stay times massively, at weekends and out of hours our discharge rate was not what it could have been.

(Emergency consultant, high-throughput site)

Limited operating hours created frustration among many of the staff involved in the trial who felt that the service they were providing was valuable and should be available 24 hours a day.

The intention will be to expand the team and gut instinct is that it should be 24 hours.

(Chest pain nurse, medium-throughput site)

Referral and recruitment

Recruitment to the trial occurred almost exclusively during the time that the chest pain nurses were on duty and was, in the words of one respondent, very ‘presence-driven’.

It’s only our when our presence is there that they think, oh the ESCAPE trial, so you turn your back and you’re on holiday and things sort of settle back to what they were.

(Chest pain nurse, medium-throughput site)

Even in the most active sites it was reported that recruitment was overlooked when they were not there. When the CPU nurses were on duty they relied largely on referrals from others including emergency department medical and nursing staff, and the medical on-take doctors. The level of this referral activity differed across sites and strategies for recruiting patients evolved differently.

In one low-activity site it was acknowledged that there were groups of patients that were being ‘missed’.

What I’d like to see is the GP-accepted patients with chest pain who refer to the medics direct, they are not going into the trial because we don’t have consultation with the medical SHOs…in terms of the medically accepted patients, we’re not there yet….

(Chest pain nurse, low-throughput site)

In a medium-activity site a similar problem had been identified but here the problem was reacted to and steps were taken to capture this group of potential recruits to the trial.
**The ESCAPE trial of chest pain units**

...they were bypassing the trial and going straight to medical admissions so we had to head them off at the pass and redirect them...to the A&E department...and as long as they were ESCAPE patients we could make the case....

(Emergency consultant, medium-throughput site)

At the most active site there was evidence of proactive recruitment behaviours by the CPU staff, of seeking out patients for the trial.

*In fact, the nurses will hang around majors in the resus room and will sniff out those patients they think who are suitable rather than waiting to be contacted by the medical staff, they’ll actively hunt them down. They’re really very good at it.*

(Emergency consultant, high-throughput site)

**Negotiating for services**

Complex negotiations with the laboratory services over achieving required turnaround times for biochemical markers, and providing the appropriate tests, was also a common experience that cut across sites in terms of activity, and some sites continued to struggle with this throughout the year of the trial.

...they promised us they would turn around something like 75% or 80% within an hour, and they promised us that...but it’s been 2 hours at least. It’s been a real struggle to get the lab times to be reasonable.

(Emergency consultant, high-throughput site)

The reasons for difficulties with biochemical tests included resource pressures on laboratory staff, particularly outside of the 09.00–17.00 hours, and the fact that for some it involved new tests that the laboratory was not set up to deliver. There was also a possible lack of engagement during initial negotiations in some sites.

*In the early stages I should have tried to get the senior people involved properly...it’s obviously an important issue to get the bloods done and they weren’t really involved...it was an error really.*

(Chest pain nurse, medium-throughput site)

Similarly, difficult negotiations with the clinical investigations departments providing the exercise test were reported by some although this was less common.

**Overcoming boundaries**

The nature of CPU care is such that roles cross traditional boundaries, for example coronary care nurses working in emergency departments, partnerships between emergency department and cardiology medical staff, or nurses undertaking exercise tolerance tests.

Crossing boundaries was experienced as undergoing something of a ‘right of passage’ by some staff and several of the nurses talked in terms of having to prove themselves before being accepted.

*It does feel much more like a team now...to be completely honest I did feel completely out on a limb when it first started and I did feel like a separate entity, a cardiac nurse who was down here, but now I suppose with the passage of time and I get used to them and they get used to us and actually I think people being able to see it works so well makes a big difference.*
The ESCAPE trial of chest pain units

(Chest pain nurse, medium-throughput site)

The main strategy that was used to overcome boundaries, other than simply allowing the passage of time, was to actively engage in educational activities to raise awareness about the nature of the role, but also to prove themselves useful, particularly to emergency department staff.

A&E just saw pressure on their beds and how busy they were and then when we went down there and started working between the two we just educated both sides didn’t we...the relationship’s better now people understand the problems a lot better.

(Chest pain nurse, high-throughput site)

...we identified learning needs early on and we have been trying to address those by teaching the doctors and nurses, and they do say can you teach us about cardiac drugs or ECGs and we say yes...we can do that for you.

(Chest pain nurse, medium-throughput site)

The data suggest that this was particularly the case in the more active sites.

7.3.3 Outputs

Effectiveness

All sites felt that the trial, as a service, had been at least partly successful. All agreed, almost without reservation, that this was a service that they should be delivering and expanding. However, it was also widely acknowledged that this would require additional funding which may not be available at present. Lack of financial support was the only reason cited for not continuing CPU care.

Very successful I think...we have seen about 90 patients and most of them were discharged, and most of them would have been admitted so...it doesn’t continue (after the trial) because we couldn’t pay for the extra resources.

(Emergency consultant, low-throughput site)

In both high- and low-activity sites the view that the trial had led to positive outcomes for the service was stated enthusiastically.

...on a scale one to ten, with ten being very successful, I would give it ten. We had a meeting towards the end of the year and the overwhelming view of everyone was that we know we can’t let this stop when the funding stops.

(Emergency consultant high-throughput site)

As a service I presented an audit to the medical team and I think it has been very successful I mean the patients are getting a better service – they’re getting hourly ECGs they’re getting CK-MB mass they’re getting a 6-hour troponin which is all better for them and they’re getting a stress test earlier. We’ve had a lot of compliments from patients who have attended who feel that the process is so much better.

(Chest pain nurse, low-throughput site)

Many of the respondents had of course invested a considerable amount in this service over a period of more than a year, which may understandably influence the data through a need to feel that this effort had produced positive outcomes. The CPU nurses particularly may have felt that the outcomes of the trial, in terms of CPU activity, reflected directly on their performance.
The ESCAPE trial of chest pain units

Respondents clearly anticipated a positive effect to be demonstrated by the ESCAPE trial data. Low-, medium- and high-activity sites reported that local audit data showed that the CPU care was having a positive impact on outcomes

...we did our own audit and it gave us the business case to keep it going.

(Cardiology consultant, medium-throughput site)

...the audit was presented in November...it was a really positive audit in favour of the ESCAPE trial.

(Chest pain nurse, low-throughput site)

The level of reported success associated with the trial was spread across a continuum from ‘moderately successful’ to ‘highly successful’ and most felt that there was what one respondent referred to as ‘added value’ from being an intervention site for the trial. The following quote from a medium-activity site suggests in some cases this added value may be substantial.

“think its succeeded more than we could ever have expected, it hasn’t just succeeded in doing what the trial set out to do…it’s actually allowed us to have a proper integrated chest pain service.

(Emergency consultant, medium-throughput site)

Role expansion and development

The data do suggest a range of positive developments that have resulted from being an intervention site for the trial. These are mainly concerned with the wider development of the chest pain services at the hospital as touched on in the previous section, and with expansion of the CPU nurse role beyond that of the low-risk ESCAPE patients. At all sites the CPU nurses had become increasingly involved in the assessment and management of both intermediate- and high-risk patients and respondents gave numerous examples of how they felt they were impacting on the care of all those presenting with chest pain or associated cardiac problems.

...with the patients identified at high risk of intervention, they have been very useful in making sure we know about those...whereas in the past nothing much happened, a patient would sit on MAU [medical admissions unit] receiving suboptimal care by today’s standards and would then land on the cardiology ward 4 days later and we would wonder why they hadn’t been for an angio[gram]...so the chest pain nurses have been instrumental in making sure those patients come to our attention within 24 hours.

(Cardiology consultant, medium-throughput site)

This role of identifying patients and facilitating timely management is one that chest pain nurses were already engaged in at the hospitals where they were well established prior to the trial, for example in sites A and D, and which is seen in other centres. Where the role was relatively new this expansion developed over the period of the trial. Other areas of practice where the chest pain nurse role was developing reflected general trends in the field and included facilitating the care of heart failure patients and establishing nurse-led arrhythmia clinics. The transfer of knowledge to emergency department staff was another area that respondents felt was a positive outcome.
The ESCAPE trial of chest pain units

The data also suggest that some felt the trial facilitated boundary-spanning and that this may have a positive impact on service development. This boundary-spanning activity was more likely to be reported in the medium- and high-activity sites.

It’s one more area that draws us together as departments because the departments get used to working together in these cross-boundary services, it’s not just one area hanging onto another but we actually have to interact closely to operate successfully so that’s a benefit.

(Emergency consultant, high-throughput site)

Visibility

Whereas four of the six sites investigated were unequivocally positive about the effectiveness of the service, two sites that had difficulty with recruitment were slightly more guarded in their enthusiasm and talked frankly about the difficulties experienced.

I think it was a success on the whole but it could have been done better...when we weren’t here nobody took it on...we’re not here all the time, and when we’re on annual leave or anything no one covers, patients that could have gone to the chest pain unit were trotted across to the MAU [medical admissions unit] for overnight stay.

(Chest pain nurse, low-throughput site)

...we’ve probably missed a lot of patients, people are just not aware enough of ESCAPE and think about it enough I think. And I don’t think that’s missing people in sending them home, I think that’s missing people as in referring them on to the inpatient teams.

(Chest pain nurse, low-throughput site)

There is a similarity in these data (although possibly for different reasons). The comments from both respondents suggest that the trial struggled to become embedded in the service and, to some extent, lacked visibility.

The junior medical staff don’t know anything about it so if one of our juniors refers to them they don’t say, oh do you think is he a candidate for ESCAPE because they don’t know anything about it...we did a presentation to the medical directorate but they’ve had umpteen changes of staff since then.

(Emergency consultant, low-throughput site)

Visibility of the service as an output of the intervention may be important in a number of ways. In the data reported here awareness of the service by others, or indeed noticing when it is not there, may impact not only upon recruitment of patients as above, but also on the motivation and sense of value of the CPU staff.

In this interview the feedback from the medical users of the CPU was clearly motivating and reassured the staff that the service they delivered was valued and needed.

Some of the consultants have passed comments, certainly over the weekend, could have done with you here yesterday because we had so many patients, and we’ve not been there so they’ve needed to admit them. So that’s quite good really, it’s reassuring.

(Chest pain nurse, high-throughput site)
The ESCAPE trial of chest pain units

By contrast the experience of this CPU team is clearly discouraging. There is a sense of isolation from these data, which is unlikely to feedback positively into the process of service delivery.

*Within cardiology it’s probably invisible, and I don’t think it was visible in A&E, it was solely us two that ran it and led it even though we had sent memos out...even when it came to an end nobody’s said anything, they didn’t seem to notice.*

(Chest pain nurse, low-throughput site)

Team-member impact

Involvement in any project or innovation inevitably has an impact on the team members. Much literature has looked at team member well-being as an important output in team-based activities. The data reported here show a range of experiences that impact upon the team members.

Some of these issues have been raised in previous sections, particularly a sense of being valued for the service provided and the long hours of work reported by some staff. As with many such roles there was a tension between wanting to deliver an effective service and the personal cost that this may require. A number of respondents felt they had made sacrifices to ensure that the service developed.

This respondent had struggled with challenging meetings and difficult interpersonal conflicts with other professionals in the development stages of the CPU. These conflicts had been significant enough to make them consider leaving the post but they persevered and now expressed great satisfaction at overcoming what was clearly a challenging period.

*I'd say I've never done anything in my nursing career of which I've been more proud...but it has been hard, I mean so hard that I was close to leaving at one time....*

(Chest pain nurse, medium-throughput site)

A further illustration of costs being balanced by rewards is seen in this respondent. Moving to a 9–5 specialist role often entails a drop in take-home pay for nurses as pay enhancements for weekends are lost but again this seems to be offset by job satisfaction.

*(We) both have taken a pay cut to do this job, we could have been on CCU nights and weekends and earned much more and so we have lost heaps of money to do it and what made the difference for us is the pair of us know how well this works.*

(Chest pain nurse, medium-throughput site)

Interestingly these costs are recognised by a senior medical colleague in a leadership role in the same site.

*The key thing for me is to create pride and ownership in the people doing the job at the delivery end of the service, because there is no other reward you can influence, I have no control for example over pay, what you can have some influence over is empowering them so that they get satisfaction from seeing that they make a difference.*

(Cardiology consultant, medium-throughput site)
The ESCAPE trial of chest pain units

This example illustrates the potential relationship between supportive and empathetic leadership and team-member well being. Although it is unrealistic to make claims about cause and effect from these data there is enough unprompted congruence between the two respondents to suggest at least a possible association. The finding is further illustrated by a converse example.

This respondent had talked of a lack of leadership support during the trial period over a range of process issues such as arrangements for exercise testing and access to medical support.

We don’t feel valued...no not really. We just get on with it and try to make sure our patients get good care, but I’m not sure anyone really notices a lot.

(Chest pain nurse, low-throughput site)

The relationship between positive feedback and self-esteem is a well known in the literature around workplace motivation and has considerable potential to impact upon performance.

Cooperative behaviours

The data suggest the development of cooperative behaviours among staff at some sites. Such behaviours are likely to be associated with an embedding and integration of the service and of acceptance by others. Reported behaviours that would have been influential for the CPU care included helping each other out in the emergency department at busy times, ward staff facilitating the transfer of patients, ECG staff working beyond normal hours to ensure timely investigations, and managers allowing flexibility of bed or trolley utilisation. These reported behaviours tended to be more prevalent in those sites with higher numbers of patients seen, but they were not exclusive to those sites. The following example from a low-activity site illustrates this.

...with the ECG department, the initial slots were at 12 and 12.30, and they were doing them in their lunchtimes to be honest, but then when somebody needed to have a stress test at 4 o'clock they also said yeah great, we’ll do it.

(Chest pain nurse, low-throughput site)

Where these cooperative behaviours are most likely to be influential in CPU activity is in the day-to-day working relationships that may facilitate recruitment of patients. In this high-activity site there is a growing interdependence between the CPU staff and the emergency department staff.

We support other staff when we’re down here, even if you have your own patient you’re not always absolutely busy with them so you can lend a hand to whatever is going on as well...because we have a lot of experience...from dealing with emergencies to simple things like taking blood off difficult patients.

(Chest pain nurse, high-throughput site)

This was accompanied by complimentary activity in the emergency department staff in facilitating recruitment.

The established nurses will sort of pre-empt...actually say is this patient suitable...they find you walking past and say oh, we might have a patient for you.

(Chest pain nurse, high-throughput site)
The ESCAPE trial of chest pain units

CPU care for the ESCAPE trial required that appropriate patients were identified as candidates before they were formally admitted, or at least within a limited timescale, that appropriately trained staff were available to assess and process these patients, that the laboratory was able to respond within an hour to a request for biochemical tests, that there was a suitable place for the patient to wait during the rule-out period that did not affect the 4-hour waiting times, that there was a facility to perform an exercise test during that visit or at least the next day, and that the patient could be discharged from CPU care without delay once the assessment process had shown it was safe to do so. From the data reported here it is clear that most if not all of these requirements were negatively affected by local organisational constraints in many of the intervention sites. At the same time the data reveal a picture of considerable effort to overcome these constraints.

7.4 Discussion

The observation that there was a considerable variation in CPU activity across the intervention sites was the trigger for this study. The findings presented here go some way towards explaining this variation and show that those sites with higher levels of activity tended to have a range of characteristics that supported this intervention. These characteristics are largely recognisable as those reported in the wider literature as supporting change and innovation (Greenhalgh et al., 2004), and are discussed below. The characteristics that are reported as being present in the high-activity sites were not necessarily confined to those sites but they tended to be present in greater numbers and with more saliency at these sites. The data also reveal some of the organisational challenges that limited activity in some sites and the reported gains to service development from taking part in the trial. This section will focus on the characteristics of the higher-activity sites and some of the challenges where these were not present.

7.4.1 Characteristics of higher-activity sites

Ready for the intervention

The concept of readiness is one that appears across the change literature and refers to the extent to which an individual or system is willing and ready for change and can be considered from the point of view of general change, or a specific change or innovation (Greenhalgh et al., 2004). Here it appears that the higher-activity sites may have been primed for this innovation by previous projects or developments. Both of the sites with highest activity levels had been involved in developments that had some of the characteristics of the CPU care prior to the intervention, including the recent acquisition of a dedicated assessment centre for chest pain patients and a well-established group of nurse practitioners in one and a history of participating in a previous chest pain study, an experience from which they had learned, in the other.

A clear leadership style

Much has been written about leadership behaviours with a multitude of theories approaching leadership from a wide range of perspectives (Yukl, 2001). One
The ESCAPE trial of chest pain units

area of at least partial agreement in the literature is that service development is more likely when leadership is present and is appropriate to the setting (Yukl, 2001). For this study a simple model of leadership style was used to describe leadership behaviour. Sadler’s familiar tell, sell, consult and join model (Sadler, 1970) conceptualises leadership as a continuum of decision-making with ‘autocratic’ manager-centred decision-making at the ‘tell’ end, and team-centred democratic decision-making at the ‘join’ end. In the data reported here there were examples of behaviours that fall under each of the four positions. In the two highest-activity sites it is likely that the key leadership behaviour was at opposite ends of this spectrum yet both appeared to be effective. Sadler’s research found that followers have most confidence in their leader when the leadership style matches their expectations. It is likely that at the time of the trial the prevailing styles of leadership in the two sites had been present for some time, was expected by the respective teams, and was effective within their own setting. The literature would however support the notion that innovation, creativity and independent behaviours are more likely to occur in the context of a more participative style. In these two sites there were important differences in the decision-making allowed by the nurses, particularly in relation to discharging patients, which, as has been discussed in the findings, may have reduced throughput of patients during the trial. This relationship between autocratic leadership and reduced autonomy has been reported in a recent study of expanding roles in emergency care (Norris and Melby, 2006). An aspect of leadership behaviour that seems to have been important in medium- and high-activity sites is ‘boundary-spanning’. Boundary-spanning is behaviour that crosses traditional organisational boundaries such as those that exist between departments or specialisms (Dollinger, 1984) and is associated with successful problem-solving. Although boundary spanning is most commonly associated with crossing external organisational boundaries, internal boundaries clearly exist between professions and between specialities, and are reported here by a number of respondents.

Positive change history

Organisations that have a positive history of innovation are more likely to be successful at change in future projects (NHS Modernisation Agency, 2003). An impression of the local change history was gained from the data through the respondents’ reflections on prevailing attitudes. Possible explanations for the sort of negative attitudes and resistance to change reported by some respondents has been widely discussed in the literature and have been reviewed from a health service perspective; they include poor dissemination of information, threats to power, seeing change as imposed, competing tasks, and lack of relevance to the individual (NHS Modernisation Agency, 2002). In the sites with higher activity this resistance to change was not seen as a significant problem and indeed examples of past innovation were volunteered. It is not possible to be certain about why particular sites gave positive change histories but of the factors that emerge from this data the literature would suggest that the reported effective leadership and staff involvement are important factors (Van de Ven, 1986).
**The ESCAPE trial of chest pain units**

**Positive relationships**

Positive, tension-free relationships between key staff and departments were more apparent in the more active sites, although not exclusively. Where tensions had arisen during the trial they were generally associated with role boundaries between staff. Role boundaries, particularly those experienced by nurses in specialist roles, have been widely reported and there are many similarities between this literature and the experiences of some of the staff here. Read (1999) and Read et al. (2001) conducted a large study (ENRiP) into new roles in nursing and allied health professions. The conflicts reported here were found to be widespread among new specialist roles across a range of settings. The ENRiP study found that conflicts were more likely to arise where there was a lack of clarity over roles and responsibilities and where the new role was poorly understood. It is interesting to note that these conflicts persist and continue to be reported (Woodward et al., 2006). Recommendations from the ENRiP study included ensuring that working arrangements and role boundaries were clear and making vigorous efforts to negotiate with those who may be affected by the role.

**A sense of shared ownership and partnership between emergency medicine and cardiology**

This was clearly seen in the two most active sites and one of the medium-activity sites. In the two low-activity sites the trial was hosted and managed more exclusively by the emergency department with varied degrees of support from cardiology, but there was not a sense of a partnership. The concepts of partnership and particularly of shared vision are seen as important to successful team working (Borrill et al., 2000) and innovation (Pearce and Ensley, 2004).

**Having an enthusiast for the trial**

A feature of both the high-activity and medium-activity sites was the continued presence of one person who was very active in maintaining and promoting the trial. Such persons are referred to as ‘champions’ (Maidique, 1980) in the innovation literature and their presence is thought to be extremely influential. The characteristics of champions that appear in the innovation literature, which tends to talk in terms of mavericks and working outside of the system, do not quite fit with the enthusiasts seen in this NHS setting. Here the behaviour ranged from quite dominant and assertive behaviour from a strong leader to quiet persistence. The literature around barriers to research utilisation also identifies the importance of having a dedicated facilitator working with staff in practice to implement research findings (Locock et al., 2001). There is a possible danger in allowing over-reliance on a ‘champion’. In the data there are examples of staff working long past the point when they should have gone off duty. This is not uncommon in such roles and was reported by the respondents in the ENRiP project (Read, 1999; Read et al., 2001), but it raises some concerns if such projects are reliant on possibly unpaid work. In the data there were several comments about the need to be present for the service to be successful and a sense of being irreplaceable. Although these work characteristics have been associated with a high degree of personal commitment and job satisfaction there may also be costs.
The ESCAPE trial of chest pain units

Proactive behaviours

During the trial year a number of problems emerged across all sites that needed to be addressed if the CPU was to continue as per the protocol. These included problems with recruitment, delays in biochemical tests, difficulties arranging or reporting the exercise test, and managing conflicting demands on time. Where there were medium to high levels of activity, examples were given of proactive behaviours, of pre-empting problems and seeking out solutions. Some of this activity seems to be related to boundary-spanning behaviour. This type of behaviour is starting to be reported in the emerging literature around nurse consultants (Woodward et al., 2006) and is likely to be important in developing new services.

Continuity of staffing during the trial period

Continuity of staff is reported as being influential in successful innovation, particularly continuity of leadership (Hughes et al., 2001). The two low-activity sites had continuity problems in that key members of staff either left or were away for an extended period during the trial. In addition these two sites reported recruitment problems for doctors at one and nursing staff at the other. Continuity was not a problem at the high-activity sites and they may have benefited from this. Continuity and stability of work teams is associated with effectiveness (Borrill et al., 2000).

7.5 Conclusions

Characteristics of the more active sites have been described and include a range of factors that are associated with successful innovation in the change literature. A number of organisational constraints have also been identified that could have impacted on the outcomes of the ESCAPE trial such as delays in discharge and laboratory tests, and on CPU activity such as missed recruitment opportunities. Respondents at most sites felt that being an intervention site for the ESCAPE trial had produced positive outcomes for service development. These outcomes included development of a comprehensive chest pain service facilitating the care of both high- and low-risk patients, the triggering of new service development such as nurse-led arrhythmia care, and the transfer of specialist knowledge to emergency department nursing and medical staff.

7.5.1 Limitations

The study is limited in two main ways. First the data are cross-sectional rather than longitudinal. This allows only a snapshot into the experience of taking part in the trial and respondents may reflect on the experience differently at the end of the trial than at the beginning or the middle. The second is that data were collected only from those closely involved with the trial. It would have been interesting to hear the voice of those who interacted with the trial but who were not part of it.

The value of the study is that data were collected from all but one of the intervention sites. This allowed comparisons to be made and to explore differences in the experience of what was intended to be the same intervention
The ESCAPE trial of chest pain units

across all sites. In addition, collecting data from each of the three core groups – nurses, emergency doctors and cardiologists – allowed the experience to be seen from differing perspectives. Also the qualitative methodology provided a rich data-set that gives a considerable insight into the experience of the respondents. Finally and importantly, having a firm outcome measure of activity allowed the data to be considered in relation to this measure and causal relationships considered.

7.5.2 Recommendations

1 Complex interventions such as the ESCAPE trial are prone to the effects of local organisational issues. Some of these effects are predictable and could be assessed prior to the establishment of the intervention.

2 Findings from single-centre studies of complex interventions should be treated with caution before a decision is taken to implement in a new setting.

3 Recruitment of staff to chest pain specialist roles should take into account such qualities as the ability to engage in proactive behaviours and not just specialist knowledge.

4 Crossing professional and organisational boundaries may still lead to conflict between staff. The recommendations from the ENRiP project should be considered when establishing new roles in practice and adequate preparation made to prepare and support new working relationships.

5 Similar cross-boundary innovations should ensure that there is active participation and support from all relevant groups.
Section 8 Discussion

The main findings of our quantitative evaluation of CPU effectiveness were that the introduction of CPU care was not associated with any significant change in the proportion of patients attending with chest pain who were admitted, and may have been associated with an increase in the proportion of emergency department attendances with chest pain, increased re-attendances and (re-)admissions, and increased emergency medical admissions. There were no significant changes in patient-reported health or satisfaction with care.

The economic evaluation showed that the introduction of CPU care was associated with a small gain in QALYs and a small reduction in health service costs, but both estimates were subject to substantial uncertainty. The suggestion from the quantitative study that the introduction of CPU care may be associated with increased attendances with chest pain undermines an important assumption in the economic analysis and casts further doubt upon the cost-effectiveness of CPU care.

8.1 Comparison with previous studies of CPU care

These findings run counter to most previous studies of CPU care. Two uncontrolled, before-and-after, single-centre studies of the introduction of CPU care in hospitals in the USA (Abbott et al., 2001; Shah et al., 2001) both found that the introduction of CPU care was associated with decreased hospital admissions, while a multi-centre registry study of hospitals with CPU care (Graff et al., 1997) showed that these hospitals admitted fewer patients compared with previous studies of patients with chest pain. These studies all used historical controls and thus carry risks of confounding by other factors, differential patient selection and the Hawthorne effect, all of which could lead to over-estimation of the effect of CPU care.

Two individual-patient (i.e. non-cluster) randomised trials from the USA (Gomez et al., 1996; Roberts et al., 1997) have compared CPU care with routine inpatient care to show that CPU care was associated with reduced hospital length of stay. Neither study allowed for the possibility that patients managed on the CPU could have been discharged home, so they cannot determine whether CPU care reduced admissions. The only previous study of CPU care that was both randomised and used a pragmatic design that allowed for control patients to be discharged home was our single-centre trial of CPU care at the Northern General Hospital in Sheffield (Goodacre et al., 2004a). This trial showed that CPU care was associated with reduced hospital admissions.

Most previous studies have only examined hospital admission or length of stay as outcomes. In terms of other outcomes, Shah et al. (2001) found that re-attendances increased after the introduction of CPU care, whereas the Sheffield trial (Goodacre et al., 2004a) showed reduced re-attendances and (re-)admissions, and the randomised trials of Gomez et al. (1996), Roberts et al. (1997) and Farkouh et al. (1998) showed no difference in re-attendances or
The ESCAPE trial of chest pain units

(re-)admissions. CPU care was associated with improved patient satisfaction in the Sheffield trial (Goodacre et al., 2004b) and a randomised trial by Rydman et al. (1997) (using same patients as Roberts et al., 1997).

There are difficulties in comparing the findings of these studies with diverse methods and settings with the current cluster-randomised trial, but there are clear inconsistencies in the results, particularly in comparison with the Sheffield trial (Goodacre et al., 2004a). We propose the following potential explanations for these inconsistent findings.

1 The study population for the ESCAPE multi-centre study included all patients with chest pain, whereas the previous randomised trials only included patients who were eligible for CPU care and consented to participate. In all the participating hospitals of the ESCAPE trial only a minority of patients with chest pain were recorded as receiving the full CPU protocol. The effectiveness of CPU care in previous randomised trials may reflect selection of patients to the trial who were ‘appropriate’ for CPU care and exclusion of those who might not have benefited or may even have suffered worse care. Conversely, the lack of effect of CPU care in our multi-centre study may reflect ‘dilution’ of the effect of CPU care among the overall population with chest pain.

2 There was some weak evidence that introduction of CPU care was associated with increased attendances with chest pain. It is plausible that this could be a genuine effect of introducing CPU care. If patients, GPs and hospital staff were aware of the introduction of CPU care then this could have led to patients with chest pain, who would otherwise have been managed at home by their GP or admitted directly to hospital, being diverted to the new service in the emergency department. Previous randomised trials would not have identified any increase in chest pain attendances because patients were either allocated to CPU or routine care on an individual patient basis or on the basis of the day of the week.

3 The CPU hospitals showed marked variation in their levels of activity and outcome measures, with some CPU hospitals being associated with changes that ran counter to the overall findings. This means that the overall results should be interpreted with caution, but also raises questions about the generalisability of findings from any study of a single CPU, such as the Sheffield CPU. It may be that CPU care is so varied in practice that we cannot expect to identify a general effect.

4 With respect to patient-reported outcomes (satisfaction with care and health utility), patients in the Sheffield trial were aware that they were being randomised to either CPU or routine care. This may have influenced their responses to the questionnaire and is acknowledged as a limitation of this study. Patients completing questionnaires in the ESCAPE multi-centre trial would have been aware that they were involved in a trial but arguably less aware of whether they received a new intervention or standard care.

The last explanation is only likely to be relevant to patient-reported outcomes and does not explain inconsistencies in the results for admissions and attendances. The first three explanations have important implications for the whole of this discussion. We need to bear in mind that the introduction of CPU care may be associated with increased attendances with chest pain (and thus a
The ESCAPE trial of chest pain units

change in the chest pain population), that the effects of CPU care may be diluted among the large numbers of patients with chest pain, and that effects may vary substantially between hospitals.

A large number of cost analyses of CPU care (De Leon et al., 1989; Gaspoz et al., 1994; Hoekstra et al., 1994; Mikhail et al., 1997; Stomel et al., 1999), including three from randomised trials (Gomez et al., 1996; Roberts et al., 1997; Farkouh et al., 1998), have all shown CPU care to be associated with lower health service costs. However, all these studies originated from the USA, where routine care for chest pain is more expensive than the UK (Goodacre et al., 2001), and most compared CPU care with inpatient care for all patients. Furthermore, none of these studies measured patient health to undertake cost-effectiveness analysis. The economic evaluation of the Sheffield trial is the only previous study that has involved cost-effectiveness analysis (as opposed to cost analysis) and is the only previous study directly relevant to the UK. It showed that CPU care was associated with a non-significant cost saving and a significant improvement in QALYs, and concluded that CPU care was likely to be cost-effective.

The findings of the economic analysis reported here are compatible with the Sheffield study. Both cost and QALY estimates favour CPU care, albeit by a smaller amount and with much greater uncertainty. However, both analyses are based upon the assumption that CPU and routine care both manage the same patient population. If, as suggested by the quantitative study, CPU care is associated with increased chest pain attendances, then CPU care is unlikely to be cost-effective unless we can demonstrate benefit to these additional attendances.

8.2 Previous studies of other interventions to reduce emergency admissions


The New Zealand Health Technology Assessment review concluded that most emergency department interventions to reduce admissions had not been evaluated with randomised controlled trials, so the effectiveness of most interventions was uncertain. There was some randomised trial evidence that specific interventions were effective at reducing admissions, including hospital-at-home schemes (Mor and Kidder, 1985; Zimmer et al., 1985; McCorkle et al., 1989; Cummings et al., 1990; Hughes et al., 1992), comprehensive geriatric care and placement of GPs in the emergency department (Dale et al., 1995, 1996; Murphy et al., 1996). Meanwhile, some interventions appeared to be unsuccessful at reducing admissions, including outpatient-based patient education (Anonymous, 1994; Osman et al., 1994; Boulet et al., 1995; Beck et al., 1997; Gibson et al., 2002), increased outpatient services (Swift et al., 1993;
The ESCAPE trial of chest pain units

Charlton et al., 1994; Silverman et al., 1995, Marius-Nunez et al., 1996;), utilisation review and case management.

Cooke et al. (2003) reviewed studies evaluating the effect of observation units upon emergency admissions and updated previous reviews on this topic (Krome, 1989; Goodacre, 1998; Cooke et al., 2003). Most studies of observation units used an uncontrolled before-and-after intervention design, so although they frequently conclude that establishment of an observation unit leads to reduction in admissions, this finding may be confounded by changes over time or differences in patient selection before and after intervention.

Rather like previous studies of CPU care, most studies of interventions to reduce emergency hospital admissions have only examined whether intervention has reduced admissions in the target population, and have not examined whether the new service attracts new patients, thus increasing admissions. However, a recently published study (Gravelle et al., 2007) evaluated case management of elderly people using a controlled, before-and-after design and measured emergency admission rates at practice-level. This showed that case management introduced an additional range of services into primary care without an associated reduction in hospital admissions, and concluded that this may have been because of identification of additional cases.

It has been recognised that apparent substitutes for hospital care may increase overall demand for services, with little impact on overall hospitalisation or costs (Henscher et al., 1999). Our study provides further evidence that interventions intended to reduce hospital admissions should be evaluated at the level of the potential population who may be affected by the service, rather than just the target population.

8.3 Organisational factors influencing CPU activity

The descriptive data from the CPUs outlined in Section 3 show that the activity of the individual CPUs varied substantially, with some reporting similar levels of activity to previously published reports (Herren et al., 2001; Goodacre et al., 2002; Taylor et al., 2002) and others reporting much lower levels of patient throughput. This has two implications for interpretation of the quantitative study: (1) The low patient throughput at some sites may contribute to the overall negative effect of CPU care, and (2) the variation in activity means that we should be cautious about drawing general conclusions about CPU effectiveness.

When it became apparent that there was variation in CPU activity that could not be easily explained by CPU structures and processes we planned an additional study to explore whether organisational factors could explain the variation in activity. The findings of this study are discussed in detail in Section 7. In summary, levels of activity may be associated with some of the following factors; whether ‘primed’ by previous similar initiatives, the nature of the relationships between key staff and departments, continuity of staffing in the CPU and it’s host department during the trial period, how leadership of the service is expressed, the climate for change and innovation, clarity of roles, the extent of proactive behaviour of the CPU nurses, and the presence or absence of

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staff with a clear responsibility and enthusiasm for driving the activity of the CPU. Many of these factors have been shown in previous studies to be influential in the successful implementation of new services.

This is the first organisational study of CPU implementation, but it is probably reasonable to assume that hospitals that have established and evaluated CPU care, and then published their findings, share many of the characteristics of hospitals in the ESCAPE trial with active CPUs. If so, this suggests that we should be cautious about extrapolating the findings of single-centre evaluations of complex interventions like CPU care to hospitals throughout the NHS. If implementation depends upon local organisational characteristics then we either need to develop ways of ensuring that implementation adapts to local circumstances or accept that the intervention will struggle to find a general role in the NHS.

8.4 Triangulation of quantitative and qualitative findings

The findings of the face-to-face patient interviews have been discussed in detail in Section 5. The use of mixed methods to evaluate the introduction of CPU care gives us the opportunity to identify common themes between the two elements of the evaluation and seek explanations for the quantitative findings among patient perceptions reported in the qualitative study.

A principal finding of the qualitative study was that the role of the chest pain nurse was acceptable to patients, but that this role was not limited to hospitals providing CPU care. We deliberately did not restrict development of chest pain services at control hospitals to allow a realistic comparison of CPU care with normal service development. It is possible that the role of the chest pain nurse can be developed and provide patient benefits without formal establishment of CPU care. This may explain why we did not detect any improvements in patient satisfaction associated with the introduction of CPU care, in contrast to previous studies (Rydman et al., 1997; Goodacre et al., 2004b).

Other important findings from the qualitative study were that patients often did not understand why tests were being done or what the results meant, and that negative testing could leave residual diagnostic uncertainty. A postulated strength of standardised CPU diagnostic assessment is that it reduces diagnostic uncertainty (Roberts et al., 1997; Goodacre et al., 2004a). This will not lead to improved patient outcomes if clinical diagnostic certainty is not communicated to patients. Indeed, there was some weak evidence from the patient questionnaires that CPU care was associated with lower satisfaction with the explanations given about tests and procedures.

The failure of CPU care to reduce hospital admissions may be explained by the experiences of patients, outlined in the qualitative study, that diagnostic testing could delay discharge from the emergency department and could even lead to hospital admission. This suggests that, although CPU care should in principal facilitate early discharge home, it may not achieve this aim in practice.
The ESCAPE trial of chest pain units

8.5 Limitations of this study

We have considered a number of potential limitations while discussing the findings of this study. The principal limitations may be summarised as follows.

1 We were only able to recruit 14 hospitals instead of the intended 18, despite contacting many hospitals and receiving expressions of interest from 80. This will have reduced the power of the study to detect differences in quantitative and economic outcomes. The initial power calculation for the study was inevitably limited by a lack of data to estimate clustering of outcomes and did not take into account the statistical power gained by measuring changes in outcomes over time. The potential importance of loss of power will vary between outcomes, so we have presented the main findings with confidence intervals so that readers can determine whether the study may have been under-powered to detect a potentially important difference. The primary outcome (proportion of chest pain attendances resulting in admission) had an adjusted odds ratio close to 1, with a 95% CI of 0.94–1.059, so it is reasonable to conclude that we have excluded a potentially important difference in this outcome. Conversely, the uncertainty surrounding the economic analysis was so substantial that this would not have been reduced by recruitment of the full compliment of 18 hospitals. However, uncertainty in some outcomes, such as the change in chest pain attendances over time, may have been critically influenced by the loss of statistical power.

2 The other important implication of the change in recruitment was that the 14 participating hospitals were highly selected (from 80 that expressed an interest) and may not therefore be representative of typical NHS hospitals. Despite this, we believe that our findings are generalisable to the NHS. First, the participating hospitals included a variety of sizes, locations and types of hospital, from the large urban to small rural hospitals. Second, one would anticipate that, if there were more subtle differences between recruited and non-recruited hospitals, we would have recruited hospitals that would be more adaptable and supportive of organisational change. Since the study produced an overall negative result in the recruited hospitals it is unlikely that hospitals that were unable or unwilling to participate would have been more able to set up and run an effective CPU than the participating hospitals.

3 The variation in the structure, processes and activity of CPUs mean that we should be cautious about generalising our findings to any specific CPU. The CPUs varied in operating characteristics and number of patients managed, with some managing a low number of patients over the year. It is possible that a specific CPU is effective, particularly if it manages a large number of patients. Nevertheless we can conclude that CPU care is unlikely to have generalisable benefits across the NHS. Our study shows what happens when we attempt to set up CPUs in a variety of hospitals. There is no reason to suspect that this process would be any more successful at other NHS hospitals. We made strenuous efforts (perhaps too strenuous) to ensure that the CPUs were active. Since, in spite of our efforts, we were unable to detect any overall benefit we should conclude that CPU care is unlikely to have widespread benefits.
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4 By taking a whole-system approach to evaluation we may have failed to identify benefits of CPU care in specific patient groups. Most patients with chest pain did not receive CPU care at the CPU hospitals so any effect of CPU care may have been diluted.

5 Only around 40% of patients responded to the questionnaire and there was some evidence of a differential response rate after CPU implementation. This low response rate means that findings may be subject to bias or unrepresentative of the population. However, it is worth pointing out that the questionnaires were mailed to an unselected population. A randomised trial that recruited 60% of the target population and achieved a response rate of 70% would be equally unrepresentative.

6 We were unable to fulfil our original intention of measuring the adverse event rate in patients discharged at initial attendance. Previous non-randomised evidence (Graff et al., 1997) has shown that CPU care is associated with lower rates of missed myocardial infarction and a randomised trial (Goodacre et al., 2004a) has shown a trend towards reduced inadvertent discharge with ACS associated with CPU care. We may therefore have missed a potential benefit of CPU care.

7 The establishment of CPU care at intervention sites was accompanied by widespread changes in emergency and cardiac care, including initiatives to reduce waiting times and implementation of prehospital thrombolysis or emergency angioplasty, and development of chest pain services at control hospitals, particularly chest pain nurses. It is possible that the effects of CPU care were ‘lost’ among the substantial changes in emergency care or were attained at control hospitals without formally establishing CPU care.

8.6 Recommendations for NHS policy and practice

This study has found no evidence of general benefit from establishing CPU care and some evidence that establishing CPU care may lead to increased hospital attendances with chest pain and increased admissions. CPU care should not therefore be established throughout the NHS.

We also make the following recommendations, based upon findings from this study.

1 New approaches to chest pain management, or modified forms of CPU care, need to be developed and evaluated. Hospital attendances with chest pain increased over the course of the study. If establishing CPU care is genuinely associated with increased chest pain attendances then there is clearly increasing and unmet demand for acute chest pain services.

2 Any alternative form of care or modified CPU approach either needs to be simpler and easier to implement than CPU care, or requires strategies to be developed to overcome barriers to implementation. These should address the issues identified in the organisational study.

3 NHS guidance that encourages patients to seek urgent medical help for chest pain, and associated publicity campaigns, need to take into account the potential impact upon patients and address the concerns raised. The
The ESCAPE trial of chest pain units

A qualitative study identified a need for clear explanations of test findings and resolution of diagnostic uncertainty.

4 New services intended to reduce emergency medical admissions by providing alternatives to inpatient care should not be implemented until they have been evaluated using robust methods and shown to achieve the desired effect. Our findings suggest that CPU care, a promising method for reducing emergency admissions, may paradoxically increase admissions.

5 Complex interventions should be evaluated in a variety of NHS settings before widespread implementation is advocated. The implementation of complex interventions, such as CPU care, depends upon local organisational factors. If evaluation of new services has only taken place in single centres then findings may not be applicable to the rest of the NHS.

8.7 Future research

We have identified a number of key areas for future research. First, and most fundamentally, there is still a need for a rapid assessment of patients with acute chest pain that accurately identifies those with ACS and allows those without to be discharged home. This needs to be simple enough to be widely implemented throughout the NHS or associated with strategies to overcome barriers to implementation. One possible approach, due to be evaluated shortly, involves using a 90-minute point-of-care cardiac marker panel.

Although simplified rule-out strategies, such as the point-of-care panel, may offer a practical alternative to hospital admission, it will not address the concerns raised by patients about diagnostic certainty. Patients interviewed in the qualitative study wanted to know what was causing their chest pain, not just that it was not cardiac. It is possible that such information simply cannot be provided, but further research is needed to identify what patients want to know and how we might best deliver it. This is especially important if public information campaigns are being used to raise awareness, and potentially anxiety, about chest pain.

It is apparent from this study that the incidence of acute chest pain presenting to hospital is increasing, and there may even be additional unmet demand. Research is needed to find out why this is. Does it represent increased incidence of cardiac chest pain, increased use of health services by those with cardiac chest pain or increased use by those with non-cardiac pain?
The ESCAPE trial of chest pain units

References


Capewell, S. 1996. The continuing rise in emergency admissions: explanations and responses must be properly evaluated. British Medical Journal 312: 991–2


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Appendices

Appendix I  EQ-5D questionnaire

Here are some simple questions about your health in general. By ticking one answer in each group below, please indicate which statements best describe your own health state TODAY.

Please tick one

1. **Mobility**
   - I have no problems in walking about  O
   - I have some problems in walking about  O
   - I am confined to bed  O

2. **Self care**
   - I have no problems with self care  O
   - I have some problems washing or dressing myself  O
   - I am unable to wash or dress myself  O

3. **Usual activities**
   - I have no problems with performing my usual activities (e.g. work, study, housework, family or leisure activities)  O
   - I have some problems with performing my usual activities  O
   - I am unable to perform my usual activities  O

4. **Pain/discomfort**
   - I have no pain or discomfort  O
   - I have moderate pain or discomfort  O
   - I have extreme pain or discomfort  O

5. **Anxiety/depression**
   - I am not anxious or depressed  O
   - I am moderately anxious or depressed  O
   - I am extremely anxious or depressed  O
Appendix II  Patient satisfaction

**Patient satisfaction with care**

We are interested in your honest opinions, whether they are positive or negative, regarding the care you received when you arrived at the hospital 1 month ago. Your answers will be confidential and will not be seen by any of the doctors or nurses who are caring for you.

Please answer all of the questions. We also welcome your comments and suggestions.

Thinking about your treatment when you attended the hospital 1 month ago, how would you rate the following? (Please circle one number on each line)

1. The thoroughness of examinations
   
<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
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2. The skill, experience and training of hospital staff
   
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3. The thoroughness of treatment
   
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4. Explanations given to you about medical procedures and tests
   
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5. Attention given to what you had to say
   
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6. Advice you got about ways to avoid illness and stay healthy
   
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7. Friendliness and courtesy shown to you by hospital staff
   
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8. Personal interest in you and your medical problems
   
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9. Respect shown to you, and attention to your privacy

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10. Reassurance and support offered to you by hospital staff

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11. Amount of time the hospital staff gave you

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12. Overall, how satisfied are you with the service you received?

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Appendix III  Resource use

Your use of health services over the last month

1. Please could you tell us if you have used any of the following services in the last month and how many times you have used these services. If you cannot remember the exact number, please give an estimate. For example, if you think it was between 4 and 6 times, please put 5. If you haven’t used the service, please enter 0.

<table>
<thead>
<tr>
<th>Service</th>
<th>Service used (please tick)</th>
<th>If YES, number of times used</th>
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<tbody>
<tr>
<td>Telephone health advice (e.g. GP, NHS Direct)</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>GP surgery consultations</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>GP home visits</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>Nurse home visits</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>Social worker visits</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>Accident and emergency attendances</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>Attendance at hospital as an outpatient</td>
<td>YES  NO</td>
<td></td>
</tr>
<tr>
<td>Other health services</td>
<td>YES  NO</td>
<td></td>
</tr>
</tbody>
</table>

2. Have you spent any nights as a hospital inpatient in the last month?

YES  NO

If YES, how many nights were you in hospital for? _______ nights

3. Have you received any diagnostic tests during the last month?

For example, an exercise treadmill test or an echocardiogram (heart scan).

YES  NO

If YES, please list them below:
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4 Have you had any operations or surgical procedures performed on you during the last month?

YES □ NO □

If YES, please list them below:

Your work over the last month

Have you taken any time off work in the last month?

YES □
NO □
I’M NOT IN PAID EMPLOYMENT □

If YES how many days did you take off in the last month? ___________ days

Please add any other comments you have in the space below then put the questionnaire in the envelope and return it to us.

Thank you for your help.

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