

# **Are Rapid Access Chest Pain Clinics effective and fair?**

## **Characteristics and outcomes of patients from six centres**

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***Report for the National Co-ordinating Centre  
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## ***Executive Summary***

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### Are rapid access chest pain clinics effective and fair: characteristics and outcomes of 8762 patients from six centres

Rapid access chest pain clinics (RACPCs), a key part of the national service framework for coronary heart disease, are now established in nearly all acute trusts in England and Wales. They aim to eliminate delay in the cardiological assessment of patients with chest pain and to distinguish those with angina from those with other causes of chest pain. We have undertaken a multi-centre cohort study of 11,082 consecutive patients attending RACPCs. Data were electronically recorded from 2 January 1996 to 31 December 2002 using identical databases in each of the six participating centres.

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### The aims of the study were:

- to determine whether RACPCs are appropriately targeted towards patients with chest pain of cardiac origin;
- to analyse populations using RACPCs, equity of access to the clinics and referral for subsequent cardiac procedures and their appropriateness;
- to compare different models of care across centres;
- to determine whether RACPCs act in addition to or as a substitute for other services.

## AIM 1: To determine whether RACPCs are appropriately targeted towards patients with chest pain of cardiac origin

### **Objectives**

- (1a) determine contemporary prognosis of patients with angina
- (1b) measure potential differences in outcomes between angina and non-cardiac chest pain patients

### **Background**

The incidence of angina in primary care populations is increasing but its prognosis is unknown. The assumption that one-stop assessment in RACPCs can successfully separate patients with stable chest pain into those with and without angina is unproven and the extent to which the differential diagnosis accurately predicts risk is unknown.

The external validity of claims made by trialists that cardiovascular risk in stable angina has been reduced to 'normal levels' is hard to gauge.

### **Methods**

The study group comprised patients diagnosed with either incident angina without prior myocardial infarction (n=2366) or non-cardiac chest pain (n=6396).

Median follow-up was 2.57 (interquartile range 1.96-4.15) years.

Mortality (ONS) and hospital admissions (NWCS) were compared with the general population and the participants (placebo groups) of recent randomised trials.

### **Results**

All outcomes were more frequent for patients diagnosed with angina compared with patients with non-cardiac chest pain. Annual rates of coronary death and non-fatal myocardial infarction were 2.3% (95% CI 1.9-2.7%) in patients with angina versus 0.4% (95% CI 0.3-0.5%) in patients with non-cardiac chest pain.

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Cumulative probabilities of these events at three years were 4.84% (95% CI 3.92-5.96) in patients with angina versus 0.90% (95% CI 0.67-1.23) in patients with non-cardiac chest pain. Differences persisted after multivariate adjustment. Out of 203 patients with coronary death or non-fatal myocardial infarction, 72 (36%) had been diagnosed with non-cardiac chest pain. They were younger, less likely to have typical symptoms, and more likely to have a normal resting ECG compared with patients with angina who had coronary death or non-fatal myocardial infarction.

Compared with the general population, standardised mortality ratios for death due to CHD were higher in men (2.03, 95% CI 1.49-2.56) and women (2.13, 95% CI 1.29-2.96) with angina. We identified no randomised trials recruiting incident cases of angina, but compared with trials that have recruited secondary and tertiary care patients, most with prior myocardial infarction, fatal and non-fatal event rates were higher in our patients with incident angina.

### **Conclusions**

Patients with previously undiagnosed angina, uncomplicated by prior myocardial infarction, are at higher coronary risk compared with both the general population and the participants in recent clinical trials. RACPCs effectively identify patients at increased risk but fail to correctly diagnose all patients. We need to improve the diagnosis and treatment of ambulatory patients when they first present with chest pain in order to reduce mortality rates in this high risk but neglected group.

(1c) Relate quantitative probability of coronary artery disease to prognosis

### **Background**

In the patient with chest pain, the diagnosis of coronary artery disease is a probability judgement based on disease prevalence in the population group to which the patient belongs and the clinical presentation. Quantitative analysis of the probability of coronary disease in an individual patient was provided by Diamond and Forrester (DF) who devised a CAD score based on that patient's age, gender and typicality of symptoms.

This analysis was based on post-mortem data in US populations and has not been tested in RACPC populations. Its prognostic validity against hard clinical end-points has never been tested.

## **Methods**

The CAD score was calculated within the database, using Diamond and Forrester's algorithm. This is based on the physician's coding of chest pain (typical, atypical, non-specific), age and gender of the patient. A modified CAD score calculated retrospectively from the individual chest pain descriptors provided an objective measure of diagnostic probability, devoid of physician's intuition.

The relation between CAD scores, rated low (<20%), intermediate (20-80%) and high (>80%), and prognosis was determined in the 7426 patients aged 30 to 69 in whom the DF algorithm could be applied.

## **Results**

Median CAD scores in patients with angina were 90.6% (IQ range 67.1-92.0%) compared with 32.4% (IQ range 14.1-54.4%) in patients with non-cardiac chest pain. Corresponding figures for modified CAD scores were 67.1% (46.1%-90.6%) and 18.6% (8.4-32.4%).

Coronary death or non-fatal myocardial infarction occurred in 0.6% of patients with low CAD scores, 1.5% of patients with intermediate CAD scores and 5% of patients with high CAD scores. Corresponding figures for modified CAD scores were 0.5%, 2.0% and 5.5%, respectively.

Cumulative incidences of coronary death or non-fatal myocardial infarction at three years were 0.64% (95% CI 0.33-1.27), 1.13% (95% CI 0.82-1.56) and 4.19% (95% CI 3.00-5.83) for patients with low, intermediate and high probabilities of CAD and 0.53% (95% CI 0.30-0.92), 1.72% (95% CI 1.29-2.30) and 4.37% (95% CI 2.91-6.52) for patients with low, intermediate and high probabilities of modified CAD respectively.

Relations between CAD scores and the cumulative incidences of death or non-fatal myocardial infarction were similar for south Asian and white patients.

## **Conclusions**

In patients with previously undiagnosed chest pain the calculated probability of CAD by the DF algorithm accords not only with diagnosis but also with prognosis, effectively stratifying patients into high, intermediate and low risk groups.

In terms of risk assessment the physician's intuitive assessment of the typicality of symptoms is as good, if not better than objective methods for risk stratification.

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Although the DF algorithm for quantifying the probability of coronary artery disease was based on a primarily White US population, its validity for risk stratification in Asian patients with chest pain is confirmed.

(1d) Identify additional baseline clinical variables that may predict outcome

### **Background**

A diagnosis of angina is independently associated with coronary death and non-fatal myocardial infarction. In this section the additional contribution of other baseline clinical variables to adverse outcomes is explored.

### **Methods**

The study population comprised the 8762 patients previously described.

Cox regression was used to estimate hazard ratios for the association of angina with coronary death or non-fatal myocardial infarction initially by adjusting for age. Those age-adjusted covariates which showed significant association ( $p < 0.05$ ) were included in the fully adjusted models.

### **Results**

In the fully adjusted model, the hazard ratio for the effect of angina on coronary death or non-fatal myocardial infarction was 2.16 (95% CI 1.40-3.34). Additional baseline variables that contributed to the hazard included abnormal resting ECG (HR 1.95, 95% CI 1.44-2.64), male gender (HR 1.89, 95% CI 1.40-2.55), increase in age (HR 1.57, 95% CI 1.38-1.80), symptom duration >4 weeks (HR 1.32, 95% CI 1.00-1.76), smoking (HR 1.48, 95% CI 1.08-2.05) and diabetes (HR 1.51, 95% CI 1.06-2.15). South Asian ethnicity increased (HR 1.20, 95% CI 0.86-1.68) and black ethnicity reduced (HR 0.37, 95% CI 0.16-0.84) the hazard of coronary death or non-fatal myocardial infarction.

### **Conclusion**

Multiple factors contribute to the hazard of adverse outcomes in patients with angina. Those factors amenable to correction may help improve prognosis. Symptoms for >4 weeks increased the hazard of adverse outcomes, re-inforcing the need for rapid assessment of the patient with chest pain. The added hazard of adverse outcomes for patients with an abnormal ECG justifies the routine recordings obtained in all patients attending RACPCs. In patients with chest pain, the increased hazard for South Asians, and reduced hazard for blacks is confirmed.

## AIM 2: To analyse populations using RACPCs, equity of access to the clinics and referral for subsequent cardiac procedures and their appropriateness

### **Objectives:**

(2a) Characterise populations using RACPCs

### **Background**

Identifying demographic characteristics of patients using RACPCs is an important starting point but precludes a judgement about equity because the incidence of heart disease varies among different demographic groups.

### **Methods**

For this analysis, 9390 patients with complete data and follow-up were identified, in which the cohort was characterised by age, gender, ethnicity and RACPC centre.

### **Results**

#### Age

Relatively more patients aged <65 yrs attended the RACPC than did older patients. The proportion of patients diagnosed with angina increased with age. Rates of coronary death and non-fatal myocardial infarction increased from <1% in patients aged <45 yrs to eight percent in patients aged ≥75 years.

#### Gender

Men comprised 54% of the cohort. They tended to be younger than women and 32% were diagnosed with angina compared with 26% of women. Rates of coronary death and non-fatal myocardial infarction were 4% in men and 2% in women.

#### Ethnicity

South Asians were younger than whites (50.78 (±11.61) versus 56.71 (±13.24) years), and less likely to be diagnosed with angina (23% versus 34%), although rates of coronary death and non-fatal myocardial infarction were 3% in both groups. In black patients, angina was

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diagnosed in only 14% of cases, and the rate of coronary death and non fatal myocardial infarction was only 1%.

Centre

Newham, the oldest RACPC, comprised 51% of the cohort. Rates of angina varied from 25% (Newham) to 46% (Blackburn). Rates of referral for angiography varied from 6% (Burnley) to 48% (Oldchurch). Annual rates of CHD death or non-fatal myocardial infarction among patients with angina varied from 1.63% (95% CI 1.30-2.03%) in Newham to 3.45% (95% CI 1.49-6.79) in Burnley.

### **Conclusion**

Unsurprisingly, diagnostic categories and outcomes vary systematically with demographic characteristics. Centres vary in relation to: diagnosis; management and outcomes; (probably reflecting differences in catchment populations) referral criteria; local management policy; frequency of clinics; and local availability of cardiac investigations.

(2b) Analyse variation in access to RACPCs by age, gender, ethnicity and deprivation

### **Background**

There is conflicting evidence in the UK of inequitable access to cardiac services and to specific interventions, such as revascularisation, for older people, women, ethnic minority groups and those from more deprived areas. On the whole this research has not adequately taken into account individual or population need. No previous research has investigated access to or referral from rapid access chest pain clinics.

### **Methods**

For analysis of equity of access to the clinics, 8322 patients with undiagnosed chest pain and first attendance at RACPCs and complete data were used.

With a relatively small number of black patients, analyses of ethnic differences were confined to whites and South Asians.

The denominator population for the RACPCs was identified by the catchment area for each clinic, which in turn was defined by the PCTs served by the respective hospitals. The 2001 census was the source for ward level data on age, gender and ethnicity.

Need was defined by the ward coronary mortality data (ONS), adjusted to conform to PCT boundary changes in 2002.



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The Townsend deprivation index calculated at ward level by using census 2001 data of percentages unemployed, with no car, not owner occupier and overcrowding was used.

Univariable and multivariable Poisson regression models were fitted to estimate attendance rates by age group, gender, ethnic group and deprivation status and similar models were fitted to estimate population CHD mortality rates.

### **Results**

Attendance rate ratios for older patients (aged  $\geq 65$  years) were similar to the younger age group, although their population CHD mortality rates were nearly 15 times higher. For those most deprived (quintile five), visit rates were 13 percent lower than those less deprived (quintile one to four) but the population CHD mortality rates were highest in the most deprived quintile. South Asians had higher attendance rates compared to the white ethnic group and a high standardised mortality ratio for CHD based on national data. Women had lower visit rates and also lower population CHD mortality ratios compared to men. Hospitals which ran clinics four to five times a week had higher attendance rates.

### **Conclusions**

We have found evidence for inequity of access to rapid access chest pain clinics for older people and those from more deprived areas, but none for women or South Asian patients.

(2c) Rates of referral for coronary angiography in relation to age, gender, ethnicity and deprivation

### **Background**

There is considerable evidence from the UK and internationally of under-investigation of heart disease in older people, women, some ethnic minority groups and people from socio-economically deprived areas. A major purpose of rapid assessment of chest pain is that it should provide access to invasive investigation equitably for all patients in whom it is indicated, regardless of demographic characteristics, to prevent or postpone coronary events.

### **Methods**

For this analysis 8446 patients, 2270 diagnosed with angina and 1554 with pre-test CAD score  $>80\%$ , were identified.

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The independent contributions of age, gender, ethnicity and deprivation towards use of exercise tolerance tests and referral for angiography were analysed by logistic regression. Sensitivity testing for the analysis of referral for angiography included sub-group analyses of patients with angina and those with a CAD score >80 percent.

### **Results**

The RACPC directly referred 544 patients (6%) for coronary angiography and a further 936 patients (11 percent) during follow up. A diagnosis of angina was the major factor associated with coronary angiography (OR 198.07, 95% CI 46.44-844.83).

Every 10 year increase in age reduced the odds of referral for coronary angiography (OR 0.72, 95% CI 0.65-0.80), as did south Asian ethnicity (OR 0.30, 95% CI 0.21-0.42), and socio-economic deprivation (OR 0.42, 95% CI 0.28-0.62) for most deprived (quintile five) of the Townsend deprivation score versus less deprived (quintile one to four). Being male increased the odds, OR 1.89, 95% CI 1.48-2.41. These associations persisted in the angina and high coronary risk subgroups. Once referred for angiography, the cumulative probability of undergoing the procedure was unaffected by age, gender, ethnicity or deprivation.

### **Conclusion**

Among patients attending RACPCs, there were significant inequities in referral for coronary angiography for older people, women, south Asians and those from more deprived wards.

(2d) Analyse appropriateness of cardiac investigation in RACPCs by applying appropriateness ratings validated in a previous study to answer questions of over-use and under-use according to age, gender, ethnicity and deprivation

## **Background**

In analysing cardiac investigation and its effect on outcomes, a more precise judgement of equity (and under-use/over-use) is possible with retrospective ascription of appropriateness of the investigation to individual patients. In a previous study we have developed appropriateness ratings (RAND-Delphi method) for stress testing (ETT) and coronary angiography.

## **Methods**

We had available 7201 patients for matching against the previously developed appropriateness ratings for ETT and coronary angiography.

Definition of under-use: appropriate investigation not performed.

Definition of over-use: inappropriate investigation performed.

## **Results**

Of the 7201 patients, 67% were appropriate for ETT, 11% were appropriate for coronary angiography. There were 26% of patients' who were appropriate for ETT but who did not receive it (under-use). In logistic regression underuse was more likely in women than men (OR 0.47, 95% CI 0.41-0.53), in South Asians than whites (OR 0.77, 95% CI 0.65-0.91), and patients older than 75 years (OR 2.16, 95% CI 1.21-3.88). At the time of consultation in the RACPC or during follow-up 46% of patients appropriate for coronary angiography did not receive it (under-use). In patients appropriate for coronary angiography, cumulative rates were similar in men and women, but lower in South Asians and older people. In spite of a higher referral rate, those patients from the least deprived areas had a lower uptake of angiography, which may reflect access to private sector investigations. Patients appropriate for coronary angiography who did not receive it were more likely to die during follow-up than patients appropriate for coronary angiography who did receive it.

## **Conclusions**

- There is considerable under-use of ETT and coronary angiography in RACPCs.
- Under-use of coronary angiography is associated with adverse outcomes.
- There is inequity in the use of ETT for women, south Asians and older patients.
- Under-use of coronary angiography is greater for older and south Asian patients.

## **AIM 3: To compare different models of care in RACPCs**

(3a) An overview of models of care in RACPCs in England and Wales

### **Background**

The RACPC we established at Newham University Hospital was the model of care proposed within the NSF for coronary heart disease.

Inevitably however as RACPCs have developed, models of care in different centres have evolved to meet local need within the constraints imposed by local facilities.

### **Methods**

A postal survey of 135 RACPCs in England, to characterise models of care currently being used was done.

### **Results**

The response rate was 75%, which was conservative as some non-responders included centres without established RACPCs. About 50% of the RACPCs were set up in response to the NSF framework for CHD, 69% had a computerized database, 97% operated with an appointment system, 53% accepted referrals only from primary care, most provided service 3-4 times a week seeing 15-16 patients per week, and 48% saw patients within 14 days. Of the 102 responders, 62 were staffed solely by doctors, 37 by both doctors and nurses and 3 by nurses. Doctors were responsible for making the final diagnosis in 93% of the RACPCs and referral for an angiogram in 95%.

### **Conclusions**

There was wide variation in the way the RACPCs are configured, differences presumably reflecting resource allocation and perceptions of local need.

***(3b) To compare waiting times in the six participating centres***

***(3c) To analyse organisational factors,***

***particularly the roles of doctors and nurses, in different participating centres***

## **Background**

A major purpose of RACPCs is to eliminate delay in the cardiological assessment of chest pain. RACPCs represent a new service within cardiology departments that has significant impact on workload. Efficient organisation, therefore, is an important priority.

## **Methods**

A senior member of staff in the 6 participating RACPCs was interviewed using a structured topic guide to provide qualitative information about the organisation of the clinic.

## **Results**

5 RACPCs met the NSF waiting time target of <14 days for all referrals. Attendance rates for all clinics plateaued after 3-4 months at a level that reflected the frequency with which clinics were held. Most clinics operated an appointment system but one was open access, increasing the potential for misuse through inappropriate referral, but having the advantage of no waiting time. This was much valued by patients.

Nurses participated in 3 clinics with roles that varied from administration, through history taking, to diagnosis and management decision making. There was a universal view that while nursing input was desirable, the doctor should be responsible for making the final diagnosis and management plan. All participants agreed that RACPCs provide a good way to overcome delay in assessment of chest pain that is beneficial to the patient. But almost all expressed frustration at the number of inappropriate referrals received despite clearly stated referral guidelines

## **Conclusions**

No single model of care best serves the main purpose of RACPCs to see patients with undifferentiated chest pain within 14 days of referral and to diagnose and initiate appropriate treatment in those with angina. Models of care must take account of local need and local facilities, but clear referral guidelines are essential if referrals are to be both appropriate and manageable.

## **AIM 4: To determine if RACPCs act in addition to or as a substitute for other services**

### **Objectives**

- (5a) Quantify the number of patients with incident chest pain who continue to be referred to the outpatient cardiology clinic (OPCC)
- (5b) Compare the distribution of cardiac and noncardiac chest pain in RACPC versus OPCC
- (5c) Analyse waiting times for assessment of chest pain in OPCC
- (5d) Compare demographic characteristics of patients with chest pain in OPCC with patients attending RACPC
- (5e) Compare rates of referral and determinants of referral for cardiac catheterisation in RACPC versus OPCC

### **Background**

RACPCs have been established to provide cardiological assessment of chest pain within 2 weeks of referral for all patients who fulfil criterion. RACPCs should substitute for existing services and reduce to zero referrals to OPCCs who fulfil criteria. It is not known if effective substitution has been achieved.

### **Methods**

Prospective study at Newham University Hospital comparing all patients referred to the RACPC over a 2 year period with those referred to the OPCC with new onset chest pain

Similar data, collected in 1382 RACPC patients and 228 OPCC patients, were stored in the same electronic database permitting direct comparison of the 2 groups.

### **Results**

Angina was diagnosed in 26% of the group seen in OPCC compared with 23% of the group seen in the RACPC Mean waiting time for an OPCC appointment was  $97 \pm 43$  days. Patients in the RACPC were seen the same day or the first working day after the referral. Only 2% of the OPCC group had had symptoms for <4 weeks at the time they were seen, compared with 67% of the RACPC group. After adjustment for the clinic waiting time

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and referral guidelines for the RACPC, there remained 30 patients with symptoms <4 weeks who were referred to OPCC.

South Asians comprised 53% of the group seen in OPCC but 45% of the group seen in RACPC. Of patients diagnosed with angina, 33% were referred for angiography from the OPCC, but only 19% from the RACPC. The adjusted odds of referral for angiography from OPCC compared with RACPC were 3.82 (95% CI 1.85-7.90)

### **Conclusion**

For assessment of new onset chest pain, the RACPC at Newham University Hospital has largely, but not completely, substituted for the OPCC. The RACPC fulfils its aim of rapid assessment with negligible waiting times compared with the OPCC. There is an unexplained tendency for South Asians being referred to the OPCC rather than the RACPC. Also unexplained is the higher rate of cardiac catheterisation for patients with angina seen in the OPCC compared with the RACPC.

### ***Variation from stated objectives in the proposal***

**(Aim 2 b)** Analyse rates of referral to angiography and revascularisation in relation to age, gender and ethnicity. Patients were referred for revascularisation following coronary angiography and not directly from the RACPC. Data on reasons for individual patient referral for revascularisation were not captured by the RACPC and NWCS database.

**(Aim 2e)** Assess access to RACPCs with comparison of proportions of patients referred to the clinics from different age groups, gender, and ethnic groups who are appropriate for referral to a cardiologist. We did not have appropriateness ratings to assess referral of patients to the chest pain clinic.

For both objectives we have analysed variation in access to rapid access chest pain clinics by age, gender, ethnicity and deprivation and rates of referral to exercise stress testing and angiography in relation to age, gender, ethnicity and deprivation.

**(Aim 3b)** Relate organisational factors, particularly the roles of doctors and nurses, in different participating centres to rates of non-invasive

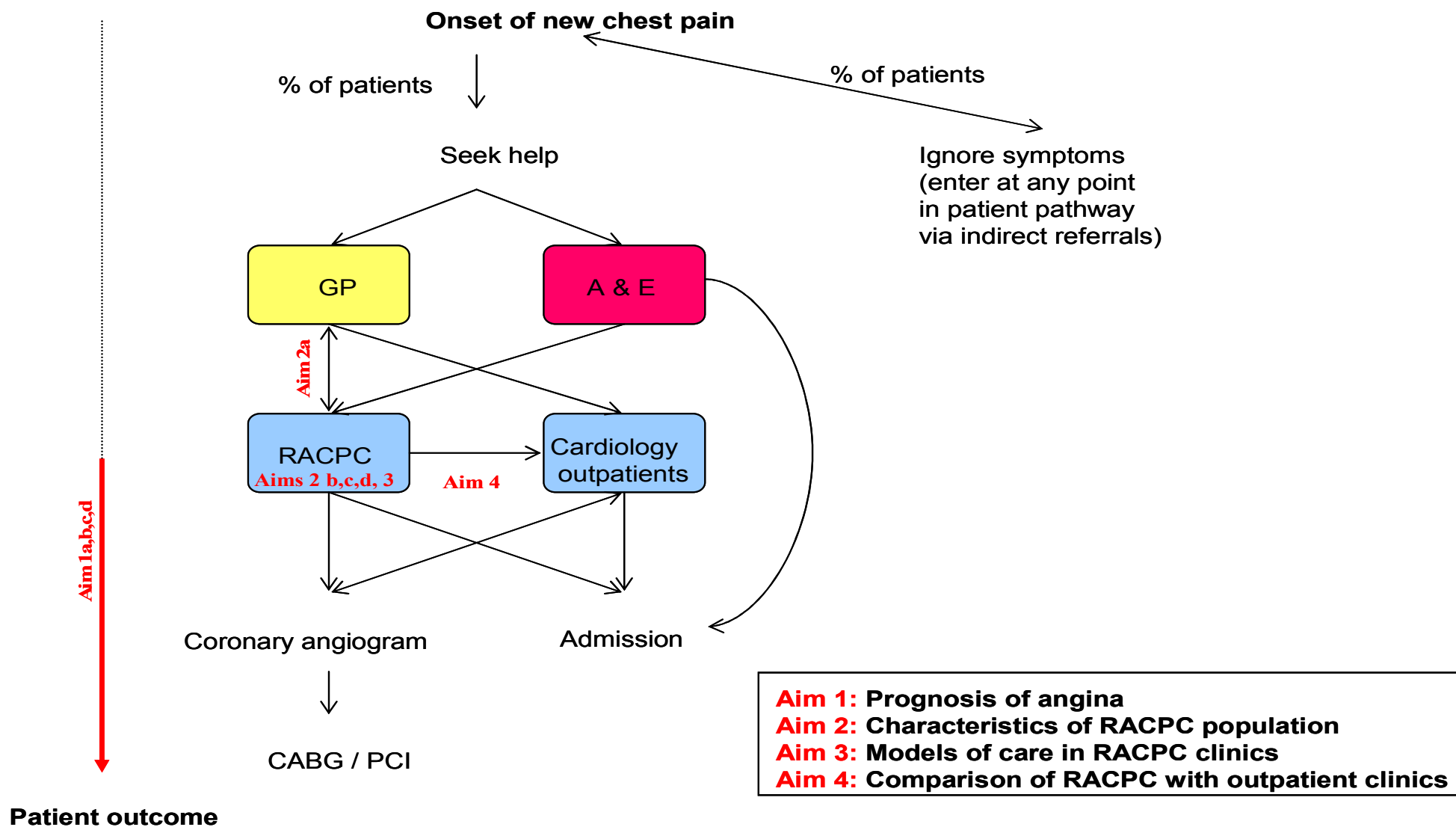


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investigation, outpatient re-attendance and clinical outcomes. Personal interviews with clinicians in the participating centres revealed that for the study period all had doctors providing clinical support. In the four clinics staffed by nurses, independent decisions were not made by them. The data from each centre reflected the doctor's assessment. **We therefore carried out an additional questionnaire survey of RACPCs in England.**

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Figure 1: Flow chart of aims and objectives in relation to the patient pathway



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**Addendum**

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