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# Electronic patient records of diagnosis and risk factor monitoring in coronary heart disease: a project to investigate and feedback completeness and consistency in a group of general practices

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The National Service Framework (NSF) for coronary heart disease (CHD) requires that all people with established CHD are identified and managed systematically; accurate and complete electronic patient records (EPRs) are thus essential. This project aimed to first establish the completeness and consistency of recording electronic information about CHD (diagnosis, risk factor monitoring and aspirin usage) across a group of general practices and secondly, to provide feedback on their performance. The third part of the project planned to evaluate the effect of this feedback on the general practices' electronic data recording but this is not reported in this article. Twenty-two of 26 general practices in one Primary Care Trust (PCT) participated. A random sample of 75 people with a Read code for CHD and/or who were taking one or more of five drugs used in CHD were selected from each of the 15 practices using Egton Medical Information Systems (EMIS) to manage their EPRs. The remaining seven practices used Torex electronic clinical system and from each of these practices, a random sample of 25 patients with a Read code for CHD was selected. Sample sizes were pragmatic rather than being chosen for possible statistical significance. At each practice the patients' paper patient records and EPRs were searched for information about CHD diagnosis, risk factor monitoring and aspirin usage. Results were fedback and discussed with each individual practice and presented to the PCT. Electronic recording of CHD diagnosis was fairly complete but recording of risk factor monitoring and aspirin usage was more inconsistently recorded. Providing feedback to the general practices raised practitioners' awareness of strengths and weaknesses in their electronic record keeping. Work to improve EPRs needs to be ongoing, to ensure that there is complete and easily accessible information about people with CHD so that their care management can be planned and implemented effectively.

**Key words:** clinical information; coronary heart disease; electronic patient records; general practice; primary care

## Introduction

Mortality and morbidity from coronary heart disease (CHD) remain substantial. In England more than 1.4 million people suffer from angina and over 100 000 people die from heart disease each year (Department of Health (DH), 2000). The National Service Framework (NSF) for CHD (DH, 2000) (Standard 3) stated that, by April 2001, general practitioners (GPs) and Primary Care Teams (PCTs) should identify all people with established cardiovascular disease and offer them comprehensive

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advice and treatment to reduce their risks. In order to achieve this, every practice should have a systematically developed and maintained register of patients with CHD, and a protocol describing their assessment, treatment and monitoring. The benefits of secondary prevention programmes for people with CHD have been clearly demonstrated (McAlister *et al*., 2001; Murchie *et al.*, 2003).

Electronic patient records (EPRs) could provide the most complete and easily accessible source of information from which to establish and maintain a CHD register, as a basis for implementing secondary prevention programmes. There are various electronic clinical systems for patient records in use: for example Egton Medical Information Systems (EMIS) and Torex. Patients' diagnoses are electronically recorded using Read codes; within this system, CHD is referred to as ischaemic heart disease (IHD) (for which it is synonymous) and the code used is G3, which has a number of subcodes, such as G33 for angina and G30 for myocardial infarction (MI). Electronic information about patients must be recorded accurately and updated regularly but it has been found that there are human and technical barriers to achieving accurate and complete electronic documentation (Thiru *et al*., 1999). Gray *et al*. (2000) also found GPs' electronic information recording to be incomplete. These authors note that when setting up CHD registers, practitioners commonly search electronically for patients with an IHD Read code and/or a prescription for a nitrate. Gray *et al*.'s (2000) study, which involved searching patients' records for evidence of a CHD diagnosis, found that this search strategy identified only 73% of patients who, on scrutinizing paper patient records (PPRs) as well as EPRs, actually had CHD. More recently, Edwards *et al*. (2002) highlighted the difficulties general practices experience in recording data systematically and consistently and the workload this entails for staff. Nevertheless, EPRs in general practice must be maintained accurately if disease management is to be approached effectively (Hogan and Wagner, 1997; Thiru *et al*., 1999; Hassey *et al.*, 2001).

An example of how EPRs can aid secondary prevention in CHD is the use of a computer program to estimate individuals' cardiovascular risk factors and identify the most effective interventions to reduce their modifiable risk factors (Hingorani and Vallance, 1999). A further example is the Morbidity Information Query and Export Syntax (MIQUEST), a set of software designed specifically to collect information from general practice computer systems. MIQUEST can collect information that has been Read coded from any system that has the appropriate 'interpreter' software installed. MIQUEST's potential is immense, for example this system was used to access the electronic notes of 2.4 million patients to collect data about CHD diagnosis, cholesterol measurements and statin usage (Lusignan *et al*., 2003). Such information can be invaluable in developing and evaluating systems for effectively managing patients with specified health problems. The information extracted by MIQUEST is, however, only as accurate and comprehensive as the electronic data entered by practice staff.

The development of a CHD information strategy can improve patient care by enabling effective monitoring and support of people known to have CHD, and also facilitates the auditing of identified performance indicators. Of particular relevance to secondary prevention of CHD is the performance indicator relating to 'fair access and effective delivery of appropriate health care':

- The number and percentage of practices in a Primary Care Group (PCG)/PCT with a systematic approach to following up people with CHD.
- The number and proportion of people aged 35–74 years with recognized CHD whose records document advice about use of aspirin (DH, 2000: 26).

The PCT funded project outlined in this article was designed in response to the NSF for CHD's performance indicator above. A systematic approach to following up people with CHD, demanded by the performance indicator, requires electronic recording of both diagnosis and risk factor monitoring in patient records. Thus the project was directed at investigating both these and, additionally, the use of aspirin – also included in the performance indicator.

The aims of the project were to:

1) Establish the completeness of information about CHD held on clinical computer systems and the consistency of its recording across a group of general practices.
2) Feedback the results to each general practice, to raise awareness of their strengths and weaknesses, and enable them to compare their performance with other general practices in the PCT.


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3) Evaluate the effects of giving feedback on subsequent completeness and consistency of electronic information about CHD in the general practices.

This article reports on the first and second parts of the project only.

## Methodology

The project took place in one PCT, consisting of 26 practices, which had established EPRs within the last 10 years. Data entry was by practice nurses, GPs and data entry clerks. The first two parts of the project were initially funded for twelve months, with the appointment of two part-time research assistants supporting one GP (the project leader), also part-time to the project. Data collection was carried out from September 2001 to the end of October 2002, with data analysis carried out on an ongoing basis, and feedback to the practices delivered when analysis was complete.

### Ethical considerations

The Local Research Ethics Committee was contacted in early 2001 and the chair advised that submission for ethical approval was not required. This was prior to the current research governance procedures being established. The two research assistants were registered nurses who ensured patient confidentiality and anonymity in their handling of patient records in accordance with their Code of Professional Conduct (Nursing and Midwifery Council, 2002). Patient numbers only were used when inputting data, and all data collected was stored securely on disks. An agreement was signed between each general practice (by the practice manager or lead GP) and the project leader. This outlined the responsibilities of each part and included a confidentiality clause.

### Recruitment of practices

All general practices in the PCT were contacted by letter and then telephoned to invite involvement in the project. Twenty-two practices agreed to take part of which 15 had EMIS and seven practices had Torex systems. The method used to collect data from the practices with EMIS differed from that used to collect data from practices with Torex as the two systems have different search facilities.

### Data collection from practices with EMIS

Figure 1 summarizes the data collection process, which took place at each of the 15 general practices, and this is further explained in three stages.

*Stage 1*

The multiple search facility of EMIS was used to identify possible patients with CHD by replicating (with three amendments) the method used by Gray *et al*. (2000). These authors demonstrated that by searching for people of 45 years and above with an IHD Read code, and/or a prescription for one or more of five drugs used in CHD management (a nitrate, atenolol, a statin, aspirin and digoxin), 96%

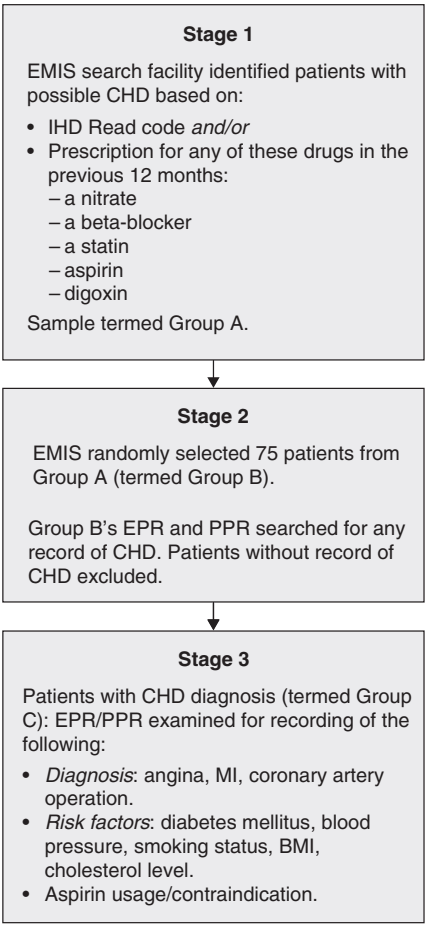


**Figure 1** Overview of data collection process for EMIS practices


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of patients with CHD can be identified. The amendments to Gray *et al*.'s (2000) strategy used in the project's search method were: no age limits were entered in the search, all drugs in the beta-blocker group were included (rather than atenolol alone) and the drug(s) must have been prescribed in the previous twelve months. These amendments were included at the decision of the project leader in discussion with the funding PCT. Thus to summarize, at each general practice, EMIS was instructed to search all EPRs for a prescription for one or more of five drugs (a nitrate, a beta-blocker, a statin, aspirin, digoxin) in the previous twelve months *and/or* the IHD Read code. EMIS has the ability to carry out this multiple search in only a few minutes, then reporting the number of patients who fitted the criteria above. For convenience, this group of people is referred to as Group A.

*Stage 2*

In each general practice EMIS was then instructed to randomly select 75 patients from Group A. A sample size of 75 was chosen pragmatically (rather than for the potential to produce statistically significant results) as it was felt to be manageable within the time constraints of the project while yielding sufficient patients with CHD to provide useful information. This group is referred to, for convenience, as Group B. The research assistants systematically examined the EPR and PPR of each of the patients in Group B in turn, for any record of CHD. Patients with no record of CHD in either the EPR or PPR were at this point excluded. The majority of these patients were taking one or more of the five drugs used in the search, for reasons other than CHD. There was no formal analysis as to which drugs were most useful in identifying patients with CHD who did not have this diagnosis Read coded. However, the researchers informally noted that a nitrate prescription was frequently associated with a CHD diagnosis, except where it had been 'tried out' for chest pain but no angina diagnosis ultimately made. Beta-blockers, however, were often prescribed for hypertension or for noncardiac conditions (e.g., anxiety). The researchers identified a small number of patients with an IHD Read code who had no record of having CHD in either their paper or electronic notes, indicating that an IHD Read code had been entered in error. These cases were noted and fedback to the practice manager individually. Patients in Group B who were found to have a CHD diagnosis are referred to as Group C. The number of patients in Group C ranged from 18 at one general practice to 31 at another, the mean being 23. This finding, that about one in three patients identified by the search strategy actually had CHD, concurred with Gray *et al*.'s (2000) results from using a similar approach. Although this search strategy was necessary to identify patients with CHD who did not have an IHD Read code, the method was very labour intensive with two-thirds of the notes reviewed then leading to exclusion of those patients from further data collection.

*Stage 3*

For each patient in Group C, data was recorded on an Excel spreadsheet (one for each general practice) using the following system. First the EPR was examined for Read coded:

- *Diagnostic information related to CHD*: angina, MI, coronary artery operations.
- *Risk factors*: diabetes mellitus, blood pressure, smoking status, body mass index (BMI), cholesterol.
- Usage, or contraindication to the usage, of aspirin for prophylaxis of cardiovascular disease.

The dates of recording of the electronic information were also entered. In a few cases the patient's EPR held Read-coded data about every one of the above and was therefore entirely complete. There was then no need to examine the EPR's free text, which is non-Read-coded data and cannot be searched for electronically, or the PPR. In most instances, some required data was not found to be Read coded. The research assistants then scrutinized first the free text recorded in the EPR and then the PPR for additional non-Read-coded information. The spreadsheet allowed for separate recording of data that was Read coded and data that was non-Read coded. At each of the practices, an additional search of the EPRs was performed using MIQUEST (discussed in this article's introduction), to provide a baseline of data in preparation for the third part of the project.

## Data collection from practices with Torex clinical systems

As the Torex systems installed did not have a multiple search facility it was not possible to search for


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patients with an IHD Read code and/or a prescription for one or more of the five drugs. Therefore an adapted search strategy was used (see Figure 2) as it was felt that these practices would still benefit from feedback about their EPRs' strengths and weaknesses. In each general practice 25 patients with an IHD Read code were randomly selected. Their EPR and PPR were reviewed, and the data collected, in the same manner as that of the Group C patients at the practices with EMIS. This data collection method had limitations in relation to the project's aims as patients with a CHD diagnosis which was not Read coded could not be identified and were therefore excluded. The data collected thus related only to patients with an IHD Read code. The additional MIQUEST search was not carried out at these practices due to incompatibility between the MIQUEST interpreter and the Torex clinical system.

## Analysis

For the Group C patients in each general practice with EMIS, the researchers calculated the percentages of patients with Read coding of CHD diagnosis, specific diagnosis (angina, MI and coronary artery operation), risk factors and aspirin usage. Percentages of patients with each of these that were recorded only in the EPR's free text or PPR, or not recorded at all, were also calculated, to provide a clear picture of the completeness of the records. For blood pressure measurement, the percentage recorded in the EPR in the last year was calculated, and for BMI, the researchers calculated the percentage recorded in the EPR in the previous five years. This was because the currency of these measurements was considered particularly important by the project leader/PCT. The data from the general practices with Torex systems were analysed in the same way, except that the first point was irrelevant as all the patients' notes reviewed had their CHD diagnosis Read coded, due to the modified search strategy described earlier.

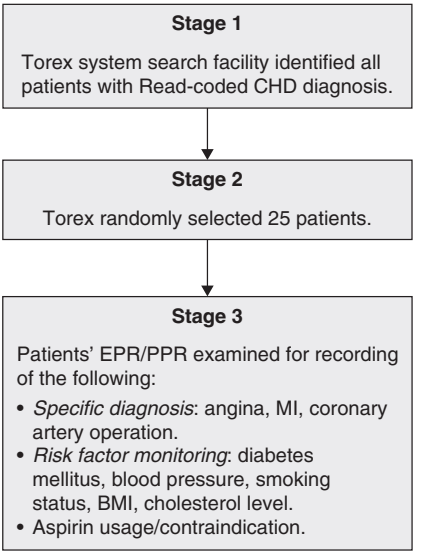


**Figure 2** Overview of data collection process for Torex system practices

## Feedback to practices

The results from the general practices with EMIS were fedback to each of them individually as a verbal presentation with visual aids, supported by written information. Each practice was also provided with a disk with the raw data recorded on the Excel spreadsheet. GPs, practice managers and practice nurses were the usual attendees at the presentations. The aim of giving detailed feedback to each practice was to promote improvements in their electronic record keeping. McCartney *et al.* (1997) used a similar approach focused on prophylactic aspirin prescribing, and concluded that giving feedback did increase Read-coded aspirin prescribing for patients with CHD. De Lusignan *et al*. (2002b) also found that giving feedback on the quality of computerized medical records led to a significant improvement in data quality. The presentation to the practices, which detailed their diagnostic information, risk factor monitoring and aspirin usage, enabled each practice to assess their strengths and weaknesses in Read-coding information about CHD compared with information available in the total patient records (EPR and PPR). The practices could also compare their results with those of the others with the same clinical system; these practices were not identified by name to maintain confidentiality.

After the results were presented, discussion took place as to how the practice could improve its electronic information recording. For example, if Read coding of cholesterol results was low, staff would discuss why this might be and how this could be improved. The practices' templates for monitoring


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CHD patients, and the training of staff who enter Read codes, were areas often raised as needing improvement. The results from the practices with Torex systems were fedback in a similar way, with each practice being able to see their own results in comparison with the anonymized results from the other Torex practices. The project's results were presented to the PCT cardiac meeting too, where representatives from all general practices were present. Here the overall performance within the PCT, and consistency of recording information across the general practices, could be considered, with a view to identifying improvements needed.

## Results

Due to the difference in how the patient searches were performed, the results from the practices with EMIS are presented separately from the practices with Torex systems. For both groups, recording of diagnosis, risk factors and aspirin usage are all discussed; tables are included to summarize the results.

### Practices with the EMIS

*Recording of diagnosis*

Table 1 summarizes the results for Read coding of diagnosis. The practices are assigned the letters A–O. For each diagnosis (CHD, MI, angina and coronary artery operation), the total identified (from examining the EPR and PPR) is given, followed by the percentage of the total that were Read coded. Only two practices (J and M) had 100% Read coding of CHD in the sample reviewed, a further nine practices achieved over 80%, and four practices (D, E, G and L) achieved less than 80% Read coding of CHD. The recording of MI was variable ranging from practice A, where 92% of patients who had had an MI were found to have this Read coded to practice G where only 44% of MIs were Read coded. Read coding of angina varied from 100% achieved at practice J to only 35% at practice M. The latter was one of the two practices with 100% Read coding of CHD; possibly Read coding of specific CHD diagnosis, using the subcodes, was not attributed the same importance. Only three practices (A, D and K) were found to have all patients' coronary artery operations Read coded. As relatively small numbers of patients have had revascularization operations it was anticipated that they would all have been Read coded. Some errors occurred because practices were not allocating angioplasties a coronary artery operation Read code.

*Recording of risk factors and aspirin usage*

Table 2 summarizes the results for Read coding of risk factors and aspirin usage. The table shows for each practice's sample, the numbers of CHD patients with each risk factor Read coded, and then those without a Read code but a noncoded (PPR or electronic record free text) recording. In instances where the two figures do not equate to

**Table 1** EMIS practices: Read coding of diagnosis

| Practice | Total CHD | Read-coded CHD % (*n*) | Total MI | Read-coded MI % (*n*) | Total angina | Read-coded angina % (*n*) | Total coronary artery operations | Read-coded coronary artery operations % (*n*) |
|---|---|---|---|---|---|---|---|---|
| A | 26 | 88 (23) | 13 | 92 (12) | 19 | 74 (14) | 7 | 100 (7) |
| B | 23 | 83 (19) | 7 | 71 (5) | 15 | 60 (9) | 2 | 50 (1) |
| C | 24 | 92 (22) | 14 | 79 (11) | 18 | 72 (13) | 6 | 67 (4) |
| D | 25 | 76 (19) | 11 | 91 (10) | 20 | 45 (9) | 8 | 100 (8) |
| E | 31 | 77 (24) | 13 | 54 (7) | 25 | 56 (14) | 4 | 50 (2) |
| F | 22 | 95 (21) | 8 | 88 (7) | 18 | 72 (13) | 6 | 83 (5) |
| G | 26 | 73 (19) | 9 | 44 (4) | 17 | 53 (9) | 6 | 50 (3) |
| H | 28 | 93 (26) | 14 | 57 (8) | 21 | 67 (14) | 6 | 67 (4) |
| I | 22 | 86 (19) | 8 | 88 (7) | 16 | 69 (11) | 4 | 50 (2) |
| J | 19 | 100 (19) | 10 | 90 (9) | 14 | 100 (14) | 1 | 0 (0) |
| K | 20 | 95 (19) | 7 | 86 (6) | 15 | 80 (12) | 2 | 100 (2) |
| L | 18 | 67 (12) | 7 | 57 (4) | 13 | 54 (7) | 6 | 50 (3) |
| M | 24 | 100 (24) | 11 | 73 (8) | 17 | 35 (6) | 3 | 67 (2) |
| N | 20 | 85 (17) | 11 | 73 (8) | 15 | 53 (8) | 5 | 80 (4) |
| O | 24 | 83 (20) | 8 | 75 (6) | 20 | 55 (11) | 9 | 67 (6) |


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**Table 2** EMIS practices: Read coding of risk factors

| Practice | Read-coded BP % (*n*) | Non-coded BP % (*n*) | Read-coded smoking status % (*n*) | Noncoded smoking status % (*n*) | Read-coded BMI % (*n*) | Non-coded BMI % (*n*) | Read-coded cholesterol % (*n*) | Noncoded cholesterol % (*n*) | Read-coded aspirin usage % (*n*) | Non-standard-coded aspirin % (*n*) | Non-coded aspirin usage % (n) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | <1 yr: 92(24)<br>>1 yr: 8 (2) | N/A | 100(26) | N/A | <5 yrs: 92 (24)<br>>5 yrs: 4 (1) | N/A | 85 (22) | N/A | 88 (23) | 12 (3) | N/A |
| B | <1 yr: 96(22)<br>>1 yr: 4 (1) | N/A | 91(21) | 4(1) | <5 yrs: 74 (17)<br>>5 yrs: 9 (2) | N/A | 83 (19) | 4 (1) | 57 (13) | 43 (10) | N/A |
| C | <1 yr: 71 (17)<br>>1 yr: 29 (7) | N/A | 100(24) | N/A | <5 yrs: 71 (17)<br>>5 yrs: 17 (4) | N/A | 88 (21) | 8 (2) | 42 (10) | 50 (12) | N/A |
| D | <1 yr: 96 (24)<br>>1 yr: 4 (1) | N/A | 100(25) | N/A | <5 yrs: 44 (11)<br>>5 yrs: 44 (11) | N/A | 80 (20) | 8 (2) | 64 (16) | 16 (4) | 4 (1) |
| E | <1 yr: 58 (18)<br>>1 yr: 32 (10) | 10(3) | 74(23) | 10(3) | <5 yrs: 52 (16)<br>>5 yrs: 23 (7) | 3(1) | 74 (23) | 3 (1) | 16 (5) | 71 (22) | 6 (2) |
| F | <1 yr: 64 (14)<br>>1 yr: 36 (8) | N/A | 95(21) | 5(1) | <5 yrs: 59 (13)<br>>5 yrs: 36 (8) | 5(1) | 77 (17) | N/A | 45 (10) | 55 (12) | N/A |
| G | <1 yr: 77 (20)<br>>1 yr: 19 (5) | N/A | 77(20) | 8(2) | <5 yrs: 35 (9)<br>>5 yrs: 31 (8) | 8(2) | 73 (19) | 8 (2) | 31 (8) | 35 (9) | 4 (1) |
| H | <1 yr: 64 (18)<br>>1 yr: 36 (10) | N/A | 93(26) | N/A | <5yrs: 43 (12)<br>>5 yrs: 46 (13) | N/A | 75 (21) | N/A | 21 (6) | 64 (18) | N/A |
| I | <1 yr: 14 (3)<br>>1 yr: 86 (19) | N/A | 95(21) | 5(1) | <5 yrs: 32 (7)<br>>5 yrs: 59 (13) | N/A | 73 (16) | 18 (4) | 0 | 86 (19) | N/A |
| J | <1 yr: 79 (15)<br>>1 yr: 21 (4) | N/A | 84(16) | N/A | <5 yrs: 74 (14)<br>>5 yrs: 11 (2) | N/A | 79 (15) | N/A | 68 (13) | 26 (5) | N/A |
| K | <1 yr: 90 (18)<br>>1 yr: 10 (2) | N/A | 95(19) | 5(1) | <5 yrs: 85 (17)<br>>5 yrs: 10 (2) | N/A | 85 (17) | 5 (1) | 45 (9) | 35 (7) | 10 (2) |
| L | <1 yr: 83 (15)<br>>1 yr: 17 (3) | N/A | 100(18) | N/A | <5 yrs: 89 (16)<br>>5 yrs: 6 (1) | N/A | 61 (11) | 28 (5) | 6 (1) | 67 (12) | 11 (2) |
| M | <1 yr: 63 (15)<br>>1 yr: 37 (9) | N/A | 71(17) | N/A | <5 yrs: 67 (16)<br>>5 yrs: 13 (3) | N/A | 75 (18) | 8 (2) | 50 (12) | 42 (10) | N/A |
| N | <1 yr: 70 (14)<br>>1 yr: 30 (6) | N/A | 100(20) | N/A | <5 yrs: 20 (4)<br>>5 yrs: 55 (11) | N/A | 65 (13) | 25 (5) | 65 (13) | 25 (5) | 5 (1) |
| O | <1 yr: 75 (18)<br>>1 yr: 25 (6) | N/A | 96(23) | N/A | <5 yrs: 67 (16)<br>>5 yrs: 17 (4) | N/A | 67 (16) | N/A | 13 (3) | 63 (15) | N/A |

BP: Blood pressure; yr: year; N/A: not applicable.

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100%, the remaining patients had no record of the risk factor in either their EPR or PPR. As can be seen, there was considerable inconsistency in the electronic recording of risk factors between the practices. Read coding of diabetes however was found to be universal and so is not included in the table. With the exception of practices E and G, all patients had a Read-coded blood pressure measurement, but there was great variation in relation to their currency. One practice (B) had Read-coded blood pressures recorded in the past year for 96% of the patients, a further nine practices achieved this in at least 70% but one practice (I) had Read-coded blood pressures in the past year for only 14% of patients. At practice L, all patients had a Read-coded blood pressure recording, of which 83% had been recorded in the past year, although only 67% of this practice's Group C had their CHD diagnosis Read coded (see Table 1). It appears that patients with CHD were having risk factors monitored even when their CHD diagnosis was not Read coded.

Smoking status was generally well recorded; at 12 of the practices over 80% of patients had their smoking status Read coded and at the remaining three practices over 70% were Read coded. Smoking status was Read coded for only 71% of patients at practice M despite all the patients having their CHD diagnosis Read coded. At practice L, however, there was 100% Read coding of smoking status, demonstrating again that patients with CHD at this practice were having their risk factors monitored, despite only 67% of the patients having their CHD diagnosis Read coded. Read coding of BMI was found in at least 80% of patients in 12 practices, with the remaining three achieving at least 60%. However, Read coding of BMI within the last five years was much less consistently recorded, ranging from 92% of patients at practice A to only 20% at practice N. At 12 practices cholesterol measurement was Read coded for over 70% of patients and the remaining three practices achieved over 60%. Ten practices had a small number of patients who had a cholesterol measurement in their PPR that had not been entered into their EPR.

Read coding of aspirin usage was approached particularly inconsistently across the practices. Some practices relied on the electronic recording of aspirin prescriptions rather than using a Read code; this is identified in Table 2 as 'nonstandard coding'. One practice (I) did not Read code aspirin usage at all. Twelve practices had some CHD patients with neither a Read code for aspirin usage/contraindication for aspirin nor an aspirin prescription. Some of the patients had a noncoded record on the PPR (e.g., that the patient had been advised to buy aspirin over the counter). However all these 12 practices had at least one patient with no reference to aspirin usage in either the PPR or EPR.

## Practices with Torex clinical systems

### *Recording of diagnosis*

Table 3 summarizes the recording of specific diagnosis at these practices, which are assigned letters P–V. As explained earlier, all records reviewed at these seven practices were of patients who had an IHD Read code. Practice Q had one patient with an IHD Read code who did not (according to the EPR/PPR) have CHD, and therefore only the remaining 24 patients are included in the results. It can be seen that Read coding was very variable, ranging from high levels achieved at practice U to the results from practice S, where specific Read code for diagnosis was entered for less than 50% of the sample. The importance attached to using IHD subcodes was evidently inconsistent across the practices.

**Table 3** Torex system practices: Read coding of diagnosis

| Practice | Total MI | Read-coded MI % (*n*) | Total angina | Read-coded angina % (*n*) | Total coronary artery operations | Read-coded coronary artery operations % (*n*) |
|---|---|---|---|---|---|---|
| P | 14 | 79 (11) | 19 | 95 (18) | 7 | 100 |
| Q | 14 | 79 (11) | 11 | 27 (3) | 3 | 33 (1) |
| R | 13 | 85 (11) | 21 | 81 (17) | 7 | 100 |
| S | 10 | 40 (4) | 10 | 40 (4) | 4 | 25 (1) |
| T | 11 | 73 (8) | 20 | 80 (16) | 8 | 63 (5) |
| U | 14 | 100 | 17 | 88 (15) | 6 | 100 |
| V | 7 | 71 (5) | 12 | 67 (8) | 2 | 50 (1) |



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**Table 4** Torex system practices: Read coding of risk factors

| Practice | Read-coded BP % (*n*) | Noncoded BP % (*n*) | Read-coded smoking status % (*n*) | Noncoded smoking status % (*n*) | Read-coded BMI % (*n*) | Noncoded BMI % (*n*) | Read-coded cholesterol % (*n*) | Noncoded cholesterol % (*n*) | Read-coded aspirin usage % (*n*) | Nonstandard-coded aspirin usage % (*n*) |
|---|---|---|---|---|---|---|---|---|---|---|
| P | <1 yr: 88 (22)<br>>1 yr: 12 (3) | N/A | 100 | N/A | <5 yrs: 60 (15)<br>>5 yrs: 40 (10) | N/A | 88 (22) | 12 (3) | 76 (19) | 24 (6) |
| Q | <1 yr: 54 (13)<br>>1 yr: 42 (10) | 4(1) | 79 (19) | 21(5) | <5 yrs: 42 (10)<br>>5 yrs: 33 (8) | N/A | 54 (13) | 46 (11) | 8 (2) | 67 (16) |
| R | <1 yr: 80 (20)<br>>1 yr: 20 (5) | N/A | 96 (24) | N/A | <5 yrs: 72 (18)<br>>5 yrs: 24 (6) | N/A | 72 (18) | 16 (4) | 28 (7) | 72 (18) |
| S | <1 yr: 72 (18)<br>>1 yr: 28 (7) | N/A | 96 (24) | 4(1) | <5 yrs: 72 (18)<br>>5 yrs: 12 (3) | 16(4) | 80 (20) | 20 (5) | 96 (24) | N/A |
| T | <1 yr: 68 (17)<br>>1 yr: 32 (8) | N/A | 84 (21) | 16(4) | <5 yrs: 8 (2)<br>>5 yrs: 36 (9) | 4(1) | 88 (22) | 4 (1) | 64 (16) | 32 (8) |
| U | <1 yr: 84 (21)<br>>1 yr: 16 (4) | N/A | 100 | N/A | <5 yrs: 56 (14)<br>>5 yrs: 32 (8) | N/A | 76 (19) | 16 (4) | 76 (19) | 24 (4) |
| V | <1 yr: 72 (18)<br>>1 yr: 28 (7) | N/A | 93 (23) | 4(1) | <5 yrs: 64 (16)<br>>5 yrs: 20 (5) | N/A | 56 (14) | 36 (9) | 84 (21) | 12 (3) |

BP: Blood pressure; yr: year; N/A: not applicable.

*Recording of risk factors and aspirin usage*

Table 4 summarizes risk factor Read coding at the practices with Torex systems. Despite the fact that, unlike the EMIS samples, all these patients had IHD Read codes, there are similar gaps apparent. At six practices all patients had a Read-coded blood pressure recording, with over 60% recorded within the last year. The remaining practice (Q) achieved Read coding of blood pressure in the last year in 55% of their patients and had one patient with no record of a blood pressure measurement. At two practices (P and U) all patients had their smoking status Read coded and the remaining practices achieved at least 70% Read coding of smoking status. Read coding of BMI ranged from practice P, where all patients had a Read-coded BMI (60% recorded in the last five years), to practice T, where only 44% of patients had a Read-coded BMI (8% recorded in the last five years). When the results were fedback several practices commented that their Torex system did not automatically calculate the BMI from weight and height measurements and that was why BMI was not always Read coded. Read coding of cholesterol measurements occurred in over 70% of patients at five practices. At the remaining two practices (Q and V) only just over half of the patients had a Read-coded cholesterol; most of their remaining patients had a cholesterol measurement in their PPR. At four practices there were a small number of patients without any record of cholesterol measurement.

As with the practices using EMIS, Read coding of aspirin usage was particularly inconsistent. This ranged from one practice (S) where 96% of patients had aspirin usage Read coded, to two practices (Q and R) with less than 30% of patients with Read-coded aspirin usage. Patients without a Read code for aspirin usage often had an aspirin prescription. There were no noncoded recordings relating to aspirin usage at any of the practices. Five of the practices had a small number of patients with no record of aspirin usage in any of their records.

## Discussion

The project's findings reveal that many general practices held the majority of information electronically that is necessary to accurately establish a CHD register, and use this to inform and monitor


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treatment. However, all practices were found to have some gaps in their EPRs, the extent of which was very variable. The project's strategy, which included individual feedback to each practice, enabled identification and targeting of those aspects needing improvement. The general practices generally responded well to the opportunity to have their CHD electronic record keeping examined, followed by feedback to raise awareness of their strengths and weaknesses and the chance to compare their performance with that of other practices in the PCT.

**Diagnosis**

Almost all of the EMIS practices were found to have some patients with a record of CHD in their PPR that was not recorded electronically. These patients could be very difficult to detect and how such a situation can be rectified is open to discussion. Interestingly these patients were often observed to be under surveillance for some other purpose (e.g., hypertension) and did have CHD risk factors recorded electronically. Practice L is a good example of this, with high percentages of CHD risk factors electronically recorded despite only two-thirds of the patients having their CHD Read coded. All health care professionals need to be vigilant for patients who may have a diagnosis of CHD that has not been Read coded. For example, staff monitoring patients for hypertension or diabetes mellitus (both CHD risk factors), could observe whether the patient has a CHD Read code and, if not, survey the electronic free text notes and PPR to ensure the Read coding of a CHD diagnosis has not been omitted. Whether such a strategy could succeed in identifying patients with non-Read-coded CHD would be worthy of study.

Read coding of specific diagnosis (MI, angina or coronary artery operation) was incomplete at both the EMIS and Torex system practices. It seemed that staff responsible for entering patient data onto the electronic data base would benefit from an update on Read codes, for example to include angioplasties within the coronary artery operations Read coding. During feedback some practices questioned why a patient with an IHD Read code needed their specific CHD diagnosis Read coded too. However it may be necessary to audit the management of these patient groups separately. For example there are targets set by the NSF for CHD for cardiac rehabilitation post-MI which relate to patients' smoking status and BMI (DH, 2000). In order to audit these targets efficiently, Read coding of MI is essential.

**Risk factor monitoring**

The gaps in electronic recording of risk factors varied between practices but some risk factors such as smoking status and blood pressure recordings were consistently fairly well recorded. BMI recording was more variable, in particular the currency of recordings; BMI could alter considerably over a period of five years so more regular recording would be desirable. The practices' electronic recording of cholesterol compared favourably with de Lusignan *et al*.'s (2003) study, where only half of patients with a Read-coded diagnosis of CHD had a blood cholesterol measurement recorded electronically. A number of the practices had electronic links to the local hospital's pathology laboratory, leading to automatic Read coding of results and the advantages of this are clear. The study did not impose an upper age limit and during feedback one practice stated that they did not measure the cholesterol of patients over 70 years of age, which accounted for their lower percentages for recording this risk factor. However this was not the approach taken by other practices. The use of templates for recording of CHD risk factors was observed to be beneficial in achieving a consistent approach to patient monitoring. As computer software packages for primary care are developed and refined, their usage will support a consistent approach to secondary prevention clinics where risk factors are monitored and recorded (de Lusignan *et al*., 2002a).

The recording of aspirin usage was particularly variable; Gray *et al*. (2000) highlighted differences in how aspirin usage is recorded. Some practices questioned the necessity to Read code aspirin usage as aspirin prescription can be detected electronically. However this stance prevented a consistent approach being undertaken across the PCT, and patients who were being advised to buy over-the-counter aspirin, cannot be identified electronically unless they have this Read coded. The development and implementation of a PCT wide protocol could ensure consistency, with all practices recording the same information for each patient and providing the same treatment, in line with the NSF for CHD (DH, 2000).



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### Limitations of the project

As already stated, due to the time-consuming nature of searching PPRs, sample sizes were small and pragmatic rather than having the potential to be statistically significant. Data collection took place over approximately one year, with collection from the Torex system practices occurring in the latter part (as the project team hoped that the facility to use MIQUEST would become available). The practices whose data collection was conducted later in the data collection period were possibly advantaged, as the accuracy of electronic patient record-keeping may have improved over the year due to the ongoing work of the PCT's NSF for CHD co-ordinator, who supported practices in developing their CHD registers. In addition, as time passes, the standards set by the NSF for CHD, and their auditing, become more firmly established.

The limitations of the Torex clinical systems, which did not provide either a multisearch facility or the opportunity to use MIQUEST, prevented the possibility of approaching all the practices in the PCT as one group. At the start of the project, the team had been assured that any incompatibilities would be resolved but this did not happen. It would be preferable for all practices to have compatible computer systems thus promoting parity in future studies and annual audits within the PCT.

## Conclusion

The project established that, in the general practices in the PCT studied, electronic information about CHD held on clinical computer systems was incomplete to varying degrees and that there was an inconsistent approach to EPRs across the PCT. The detailed feedback to each individual general practice raised practitioners' awareness of their strengths and weaknesses, and provided a forum for discussing how improvements could be made. The PCT was able to gain insight into the general practices' overall performance and consistency of electronic data recording. While the project's focus was CHD, triggered by the performance indicators in the NSF for CHD (DH, 2000), there are implications for the effective management of other chronic diseases. These also require complete and accurate EPRs, and this would be a useful area for further research.

## References

**Department of Health.** 2000: *National Service Framework for Coronary Heart Disease*. London: Department of Health.

**Edwards, R., Murphy, P., Allan, K.J.** and **Gordon, S.** 2002: Comparative morbidity data in primary care – the Northumberland MEDICS Project. *Primary Health Care Research and Development* 3, 238–48.

**Gray, J., Majeed, A., Kerry, S.** and **Rowlands, G.** 2000: Identifying patients with ischaemic heart disease in general practice: cross sectional study of paper and computerised medical records. *British Medical Journal* 321, 548–50.

**Hassey, A., Gerrett, D.** and **Wilson, A.** 2001: A survey of validity and utility of electronic patient records in a general practice. *British Medical Journal* 322, 1401–405.

**Hingorani, A.** and **Vallance, P.** 1999: A simple computer program for guiding management of cardiovascular risk factors and prescribing. *British Medical Journal* 318, 101–105.

**Hogan, W.R.** and **Wagner, M.M.** 1997: Accuracy of data in computer-based patient records. *Journal of the American Medical Informatics Association* 4, 342–55.

**de Lusignan, S., Wells, S.E., Russell, C., Bevington, W.P.** and **Arrowsmith, P.** 2002a: Development of an assessment tool to measure the influence of clinical software on the delivery of high quality consultations. A study comparing two computerized medical record systems in a nurse run heart clinic in a general practice setting. *Medical Informatics & the Internet in Medicine* 27, 267–80.

**de Lusignan, S., Stephens, P.N., Adal, N.** and **Majeed, A.** 2002b: Does feedback improve the quality of computerized medical records in primary care? *Journal of American Medical Informatics Association* 9, 395–401.

**de Lusignan, S., Dzregah, B., Hague, N.** and **Chan, T.** 2003: Cholesterol management in patients with IHD: an audit-based appraisal of progress towards clinical targets in primary care. *British Journal of Cardiology* 10, 223–28.

**McAlister, F.A., Lawson, F.M.E., Teo, K.K.** and **Armstrong, P.W.** 2001: Randomised trials of secondary prevention programmes in coronary heart disease: systematic review. *British Medical Journal* 323, 957–62.

**McCartney, P., MacDowell, W.** and **Thorogood, M.** 1997: A randomised controlled trial of feedback to general practitioners of their prophylactic aspirin prescribing. *British Medical Journal* 315, 35–36.

**Murchie, P., Campbell, N.C., Ritchie, L.D, Simpson, J.A.** and **Thain, J.** 2003: Secondary prevention clinics for coronary heart disease: four year follow up of a randomised controlled trial in primary care. *British Medical Journal* 326, 84.

**Nursing and Midwifery Council.** 2002: *The Code of Professional Conduct*. London: Nursing and Midwifery Council.

**Thiru, K., de Lusignan, S.** and **Hague, N.** 1999: Have the completeness and accuracy of computer medical records in general practice improved in the last five years? The report of a two-practice pilot study. *Health Informatics Journal* 5, 224–32.


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