The use of nitrates, calcium channel blockers and ACE inhibitors in primary care in the Northern Region: a pharmacoepidemiological study

S. J. ROBERTS & D. N. BATEMAN

Northern Regional Drug and Therapeutics Centre, Wolfson Unit of Clinical Pharmacology, University of Newcastle, Newcastle upon Tyne

- 1 Prescribing rates for cardiovascular drugs have substantial local variation. The objectives of this study were to determine the prescribing prevalence of nitrates, calcium channel blockers and angiotensin-converting enzyme inhibitors in general practice, to examine the indications recorded for these prescriptions, and to identify which therapeutic areas contribute to the variation in prescribing.
- 2 Anonymised patient-specific prescription data were taken from computerised records in 41 VAMP research practices in the Northern Region (total population 330,749). All patients who received any prescription for calcium channel blockers, nitrates or angiotensin-converting enzyme (ACE) inhibitors during a 12 month period were included. Prescribing rates were determined in terms of patients per 1,000 population within age, sex and diagnostic groups.
- 3 Overall, 4.3% of the study population were prescribed one or more of the drugs. There was virtually no prescribing for patients under the age of 35 years, but thereafter the prevalences rose steeply to peak at ages 65–74 years for calcium channel blockers (91 per 1,000 population) and ACE inhibitors (34 per 1,000), and at ages 75–84 years for nitrates (100 per 1,000). Prescribing prevalence amongst the over 85's was less than half the peak rate for each drug group. Rates for men and women were comparable, except for nitrates where men had higher rates.
- 4 Recorded indication rates for patients with ischaemic heart disease and treated with any of these drugs reached 112 per 1,000 population in the 75–84 age group, and were higher in men than women, at all ages. Hypertension indication rates were substantially higher in women over 65; across the genders the peak rate was 88 per 1,000 for those aged 65–74 years. Cardiac failure rates had an older age profile with a much lower peak of 40 per 1,000 population at ages 75–84 years.
- 5 For patients with IHD the relative use of calcium channel blockers in preference to cheaper nitrates, declined with age. For patients with hypertension the use of ACE inhibitors relative to calcium channel blockers showed a similar decline.
- 6 Whilst practices had similar profiles of prescribing with respect to patient age and gender, absolute prescribing rates varied substantially for hypertension and IHD, but less so for cardiac failure indications. This variability suggests that treatment guidelines for hypertension are not uniformly adopted or interpreted in primary care.

Keywords prescribing primary care ACE inhibitor calcium channel blocker nitrate hypertension ischaemic heart disease heart failure

Introduction

The importance of cardiovascular disease as a cause of morbidity in the community is increasingly being stressed. The pharmaceutical industry has invested large amounts of money in the development of new treatments for the management of cardiovascular disease, particularly in the areas of ischaemic heart disease (IHD) and hypertension. Although drugs such as nitrates have been in use for many years, calcium channel blockers and angiotensin-converting enzyme (ACE) inhibitors are increasingly used in the management of cardiovascular disease. These drugs have a variety of cardiovascular indications, for example IHD or hypertension in the case of calcium channel blockers, and heart failure or hypertension in the case of ACE inhibitors. The uptake of these newer agents in general practice may be influenced by a variety of local factors, including health promotion or specific hypertension clinics.

Present prescribing sources (PACT, produced by the Prescription Pricing Authority) concentrate on the overall amounts of drugs prescribed, and give no details as to the types of patients receiving them. Patient age and gender are acknowledged to affect prescribing rates generally [1, 2], and in particular cardiovascular prescribing which is almost non-existent for younger patients [3].

The purpose of this study was, therefore, to examine within a primary care setting the indications for, and profile of use of, ACE inhibitors, calcium channel blockers and nitrates. The general practices studied all lie in the Northern Region, which has one of the highest levels of cardiovascular mortality [4] and morbidity in England. The available data on prescribing volume suggest considerable variation in the uptake of these cardiovascular drugs, even within the region [5].

The study looked at the age and gender profile of patients receiving the drugs, the indications for which they were prescribed, and the relative preponderance of the principal indications within each of the three drug groups. Variability of these prescribing characteristics between groups of practices in the Northern Region was also examined. Practitioners can choose amongst alternative drugs for the treatment of a particular indication, and the relative use of alternatives may have systematic influences such as patient age or practitioner preference. These were investigated, particularly with respect to the use of nitrates and calcium channel blockers in the management of IHD.

Methods

Data

The patient-specific prescribing data analysed were for 41 practices in the Northern Region who used the VAMP general practitioner computer system, and whose data had been validated for inclusion in the VAMP research databank. The data from each prac-

tice covered a 12 month period, which for the majority ended in the first quarter of 1993, but in four practices related to earlier periods (ending in December 1992, October 1992, February 1992 and February 1991). To maintain patient and practice confidentiality the data were amalgamated into practice groups on a geographical basis; seven of the eight groups were based on individual FHSA's, and the eighth consisted of one research practice in North Tyneside and two in Gateshead.

Patients were included if they received one or more prescriptions for ACE inhibitors, nitrates or calcium channel blockers during the study period. These drugs comprise subsections 2.5.5, 2.6.1 and 2.6.2 respectively of British National Formulary chapter 2 (cardiovascular drugs). For every patient the data included: the practice location, the patient's age and gender, and drug-related information on daily dose, number of prescriptions issued during the year, and indications for prescriptions. Both daily dose and indications, derived from OXMIS [6] codes for a wide variety of diagnostic terms, were those associated with the first prescription for the drug during the study period. Analysis was based on the three principal indications for these drugs: ischaemic heart disease (predominantly angina), hypertension and heart failure. Details of the diagnostic terms and their OXMIS codes are available from the authors. Prescriptions issued without an indication or with indications relating to other disease categories were both classified as 'none/other'.

The 41 study practices had a total of 330,749 patients, comprising 10.5% of the registered population of the Northern Regional Health Authority (NRHA). Practice groups comprised between 3 and 8 practices, and included between 7% and 23.4% of the resident populations in the corresponding geographical areas (i.e. Family Health Service Authorities). For each group of practices, the registered population breakdown according to ageband and gender was available, as was the comparable information for the entire FHSA's register.

For comparison, numbers of items, at the FHSA level and for the same British National Formulary subsections, were obtained from aggregated FHSA Prescribing Catalogues for the year ending 31 March 1993.

Analysis

The numbers of patients who received one or more cardiovascular prescriptions during the study period were analysed according to the patient's age, gender, practice group (FHSA), drug group (ACE inhibitor, nitrate or calcium channel blocker), and indication for prescription. Patients who received two or more different drugs from within a drug group (e.g. two different ACE inhibitors) counted only once towards that group, and patients receiving several drugs from different drug groups counted once towards each of the groups concerned. Prescribing prevalences were defined as the number of patients in receipt of a prescription per 1,000 registered population, within age

and gender categories. Rates were calculated both regionally, and individually for geographical practice groups.

For each of the three drug groups, the average number of prescription items issued per patient was calculated according to patient age and practice group. Where patients received more than one preparation within the same therapeutic group, the number of items was defined as the sum for all these preparations.

After classification into three broad diagnostic categories, (IHD, hypertension and cardiac failure), the prescription indications were analysed with respect to patient age and gender. For each indication, the prevalence of patients receiving medication was calculated, both within the appropriate drug groups and as an overall rate. Thus, prevalences of nitrates and calcium channel blocker treatments were each considered for IHD indications, ACE inhibitors and calcium channel blockers for hypertension indications, and ACE inhibitors and nitrates for use in cardiac failure.

The effects of patient age, gender, prescription indication and practice group on prescribing prevalence rates were examined using log-linear models in GLIM4 [7].

Comparisons between prescribing in study practices and in the local populations

Prescribing rates, particularly for cardiovascular drugs, are known to vary substantially with patient age and gender [2, 3]. To make valid comparisons between the prescribing observed in the study practices and the equivalent prescribing for the local resident populations, demographic differences were accommodated by using age-sex specific rates obtained from the study practices. Indirect standardisation methods [8] were used to calculate the expected number of items for each drug group, both regionally and at FHSA level. Confidence limits for estimates were obtained by assuming that the number of patients in receipt of prescriptions for a drug was binomially distributed with the proportion dependent on the patient age/sex band. The mean and variance of the number of prescription items per patient (conditional on receiving a prescription) was estimated by the sample mean and variance derived from the corresponding age/sex band of the study data.

Results

Age/sex specific prescribing prevalence rates

During the study period 14,212 patients (4.3% of study population) were prescribed cardiovascular drugs from the three therapeutic groups considered, and 3,992 of these received drugs from more than one group. ACE inhibitors were prescribed for 3,312 patients (1% of the population) and the numbers prescribed nitrates and calcium channel blockers were more than double at 7,589 (2.3%) for each. The different combinations of therapy prescribed are shown in Table 1. These combinations may represent either consecutive or concurrent treatments during the study period.

For all three groups of drugs the number of patients were sufficiently large to allow analysis by patient age and gender, and by practice group. Figure 1 shows the age-sex specific patient prevalence rates for all 41 practices combined. Under the age of 35 years there were only 50 patients prescribed ACE inhibitors, 14 prescribed nitrates and 114 prescribed calcium channel blockers, leading to very low prevalence rates for these agebands. The rates for each drug group rose from the 45–54 year ageband but fell back to less than half the peak rates in the oldest group, 85 years and over. The prescribing prevalences for ACE inhibitors were similar in profile for men and women. This profile was shifted towards a slightly younger age in men, although peak prevalence was similar in men and women at 34 patients per 1,000 population amongst those aged 65–74 years. For nitrates, the rates were higher for men than women in all except the oldest ageband. In addition, nitrate prescribing started younger and peaked at a younger age in males (106 per 1,000 population at ages 65–74 years), as compared with females (95 per 1,000 at ages 75–84 years). The younger onset of prescribing in males was also discernible for calcium channel blockers, though the peak prevalence was at the same age (65–74 years) for both men (96 per 1,000) and women (86 per 1,000).

Although the general profiles of prescribing with respect to patient age and gender were the same for individual groups of practices as for all practices combined, there were wide disparities in their absolute levels of prescribing. This was particularly so for ACE inhibitors, where the practice group with highest prevalence had approximately three times the

Table 1 Numbers of study patients prescribed different combinations of drug therapy

	Number (%) of patients prescribed		
	ACE inhibitor	Nitrate	Calcium channel blocker
Alone	2098 (63)	4060 (53)	4062 (53)
+ ACE inhibitor		465 (6)	463 (6)
+ nitrate	465 (14)		2778 (37)
+ calcium channel blocker	463 (14)	2778 (37)	
All three drugs	286 (9)	286 (4)	286 (4)
Total	3312	7589	7589

Figure 1 Prescribing prevalences for ACE inhibitors (—), nitrates (---) and calcium channel blockers (----). ○ females, ● males.

combined rate for all study practices. However, each practice group displayed relatively consistent prescribing behaviour across the three types of drugs, with the same group (Sunderland) having the highest prevalences for all three (approximately 1.6 times the combined practices' rate for nitrates, 1.8 times for calcium channel blockers, and 3 times for ACE inhibitors). For other practice groups the prevalence rates were more closely grouped for each drug, being between two-thirds and one-and-a-half times the pooled practice rates shown in Figure 1.

Frequency of prescribing

The numbers of patients under the age of 35 years were too small to allow detailed analysis of the number of prescription items they received annually. For those aged 35 years or over, there was very little variation in the average number of ACE inhibitor prescriptions per annum according to patient age and gender, or according to practice group—the annual average was 7.3 items. The comparable figure for both nitrates and calcium channel blockers was also 7.3, but with these drugs the annual rate increased slightly with patient age, ranging from 5.4 (nitrates) or 5.6 (calcium channel blockers) for the ageband 35–44 to 7.5 items for the over 75s. This age trend in annual prescribing frequencies for nitrates and calcium channel blockers was due to a decrease in the proportion of patients receiving just one prescription during the year (nitrates: 43% down to 18%; channel blockers: 17% down to 8%) and a corresponding increase in the proportion receiving regular repeat prescriptions.

Indications for prescription

Figure 2 shows the prevalence of patients for each of the three primary indications—IHD, hypertension and cardiac failure—who received one or more of the therapies under consideration. The prevalence curves for IHD and hypertension are similar in character, with sharp increases between the 45–54 and 55–64 year agebands, a continuing rise to around age 75 years, and then a marked decline in the over 85s. The differences between men and women in IHD prevalences closely mirror the differences observed in prescribing prevalence of nitrates (Figure 1). The hypertension indication rates were marginally higher for men than women amongst the under 65 year olds, but in older patients rates for women were 20–65% higher than for men of the same age. Cardiac failure was less frequently indicated than either IHD or hypertension, and the indication rates increased at a later age, only falling back slightly amongst the very elderly (Figure 2). The indication prevalence rates are based solely on patients prescribed ACE inhibitors, nitrates or calcium channel blockers, and do not include patients receiving alternative therapies for these diagnoses.

For a single drug group prescribed for a specific indication, prevalence rates followed the general age-related pattern for that indication (Figure 2). For example, the age patterns of ACE inhibitor and calcium channel blocker treatments for hypertension were both similar to that for hypertension treatments overall. However, as some patients received both of these drugs, the overall prescribing prevalence for hypertension is less than the sum of those for the two drugs groups individually.

Figure 2 Prevalence of IHD (—), hypertension (---) and heart failure (···) as indications for prescribed drugs. ○ females, ● males.

Many patients had more than one recorded prescription indication and others, particularly the elderly, were prescribed drugs from more than one of the three drug groups during the study period. Figure 3 shows the breakdown of prescription indications according to appropriate indications for each drug group. The analysis for ACE inhibitors (Figure 3a) included all patients of 35 years and over who received ACE inhibitors, whether or not they were also prescribed drugs in other groups. A sole indication of IHD was classed as 'other or none'; an IHD indication in conjunction with hypertension and/or cardiac failure was classed according to these concurrent indications. In a similar way, the analysis for patients prescribed nitrates ignored hypertension indications (Figure 3b), and for calcium channel blockers ignored cardiac failure indications (Figure 3c). Under the age of 65 years, more than 80% of ACE inhibitors were prescribed for hypertension alone, but the proportion attributable to cardiac failure, alone or in conjunction with hypertension, rose steadily with age to reach 68% in the over 85s (Figure 3a). However, the absolute numbers in the oldest age group were low (118 patients) due to the combined effects of a small population and a low prescribing prevalence for ACE inhibitors. Nitrates were very predominately prescribed for IHD, with a few elderly patients receiving them for a sole indication of cardiac failure (Figure 3b). Calcium channel blocker prescribing was fairly evenly split between hypertension and IHD indications when considered across all age groups (Figure 3c): hypertension was an indication in approximately 60% of patients at all ages, but the proportion of patients with IHD increased with age (36% at ages 35–44 years, 67% at age 85 years or over) and this was associated with an increase in the use of calcium

channel blockers for both IHD and hypertension in the same patient.

Age trends in choice of treatment

ACE inhibitors and calcium channel blockers together account for a proportion of all hypertension prescribing, which may vary with age, but this proportion could not be derived from the study data. However, the relative usage of ACE inhibitors and calcium channel blockers could be calculated. Although the age-related prevalence of hypertension-indicated prescribing appears similar for the two drugs, there was a consistent trend towards greater use of calcium channel blockers in older patients. Table 2 gives the relative rates according to patient age, both for all patients with a hypertension indication and for those with a sole indication of hypertension. The latter ratio excludes hypertension patients with concurrent indications which could have affected the choice of treatment. Both ratios show a significant increase in the use of calcium channel blockers relative to ACE inhibitors.

A comparable analysis of patients with IHD indications shows an increase in the use of nitrates relative to calcium channel blockers with age. Again the increase is evident both for all IHD patients and for those with IHD as a sole indication (Table 2).

The prevalence of cardiac failure indications is low, so patient numbers are small, but analysis suggests a relative decline in ACE inhibitor prescribing in the elderly, when compared with nitrate prescribing for this indication.

For all these indications the trend is towards relatively lower usage of newer drugs for the same indications in the elderly as compared with younger

Figure 3 Indications for prescriptions of cardiovascular drugs, by patient age.

patients. This may, in part, be accounted for by long-term prescribing for a chronic condition which was initiated in elderly patients before ACE inhibitors were marketed. The study data do not, however, include the overall duration of prescribing for each patient.

Comparisons between groups of practices

As previously noted, the prescribing rates varied considerably between the eight groups of practices in the study. Log-linear models were used to determine the effects of patient age, gender and practice group on prescribing prevalence amongst the population aged 35 years or over. For each of the three groups of drugs, the main effects of all these factors and the age-gender interactions were significant. The magnitude of the practice effects differed for ACE inhibitors, nitrates and calcium channel blockers, but similar orderings of practice groups applied to all three groups of drugs. Interaction terms between practice group and patient ageband and gender added little to the explanatory power of the models, suggesting that the differences between practices groups were principally across-the-board proportional changes in prescribing rates, applying irrespective of patient age or gender.

The possible sources of inter-practice variation were further investigated by including the diagnostic indications as additional factors in the prescribing model. For each drug group, point estimates and 95% confidence estimates of the practice groups' relative rates of prescribing within diagnostic indications are given in Table 3. For both ACE inhibitors and nitrates prescribed for cardiac failure the effects associated with practice groups were small, but for the other diagnostic indications (IHD, hypertension) the practice group remained a significant factor. Practice groups thus appeared to have comparable rates of prescribing of these drugs for cardiac failure indications, but were not consistent in their prescribing policies for hypertension and IHD. In particular, the prescribing prevalence of ACE inhibitors for hypertension varied six-fold between the lowest and highest of the eight practice groups, with the highest group also having the highest rates of calcium channel blocker prescribing for hypertension. The reasons for this variability could derive from differences in local morbidity rates, but a more likely source is practices' treatment rates, and their choice of cardiovascular vasodilators as opposed to other drugs when treating hypertension.

Comparisons between prescribing in study practices and in the local population

The proportion of elderly patients in the study practices was slightly higher than in the registered population of the Northern Region, and there were more women (female/male ratio of 1.10 as compared with 1.04). These demographic differences needed to be incorporated in any comparisons between the prescribing rates observed in the study and those relating to the entire local population.

Estimates and 95% confidence limits, of the annual numbers of ACE inhibitor, nitrates and calcium channel blocker prescription items for the local populations were based on the demography of each FHSA's population, and the age-sex specific prevalence rates and annual items per patient observed in the corre-

Table 2 Relative prescribing rates (95% confidence limits) for different cardiovascular vasodilators associated with the same diagnostic indication. Ratios of prescribing prevalences indicate the effect of patient age on the relative use of alternative drugs

Ages (years)	Calcium channel blockers /ACE inhibitors	Nitrates/calcium channel blockers	Nitrates/ACE inhibitors
<i>For patients with indications which include</i>			
	<i>Hypertension</i>	<i>IHD</i>	<i>Cardiac failure</i>
45–54	1.16 (1.06 1.27)	1.32 (1.23 1.43)	1.15 (0.87 1.51)
55–64	1.61 (1.50 1.72)	1.43 (1.36 1.49)	1.47 (1.26 1.72)
65–74	2.15 (2.02 2.30)	1.67 (1.61 1.74)	1.92 (1.72 2.14)
75–84	2.28 (2.07 2.51)	1.91 (1.81 2.01)	2.25 (2.01 2.51)
85+	2.16 (1.66 2.83)	2.61 (2.27 3.00)	2.43 (1.98 2.97)
*Regression	$t = 7.36, P < 0.01$	$t = 4.56, P < 0.05$	$t = 6.93, P < 0.01$
<i>For patients with sole indication of</i>			
	<i>Hypertension</i>	<i>IHD</i>	<i>Cardiac failure</i>
45–54	0.91 (0.82 1.01)	1.64 (1.48 1.81)	
55–64	1.35 (1.25 1.46)	1.71 (1.60 1.81)	0.63 (0.35 1.12)
65–74	1.88 (1.73 2.03)	2.03 (1.91 2.15)	0.68 (0.47 0.99)
75–84	2.09 (1.84 2.36)	2.30 (2.11 2.50)	0.68 (0.50 0.93)
85+	2.29 (1.54 3.39)	3.03 (2.42 3.80)	1.05 (0.67 1.64)
*Regression	$t = 6.51, P < 0.01$	$t = 6.36, P < 0.01$	$t = 1.99, P > 0.05$

*Results of regression analysis for log(relative rates) on patient ageband, weighted according to sample variances of individual data points.

Table 3 Estimates (95% confidence limits) of relative prescribing rates for groups of practices, according to drug group and indication, and adjusted for patient age and gender. Rates are calculated relative to Cleveland practices (1.00)

Drug group	Practice group	Prescription indication		
		Cardiac failure	Hypertension	IHD
ACE inhibitor	Cleveland	1.00	1.00	
	Cumbria	1.32 (0.97 1.80)	1.20 (0.95 1.51)	
	Durham	0.90 (0.63 1.30)	1.82 (1.45 2.29)	
	Northumberland	1.77 (1.31 2.39)	1.49 (1.19 1.88)	
	Newcastle	1.21 (0.89 1.65)	0.93 (0.73 1.18)	
	Gateshead & N. Tyneside	1.19 (0.83 1.70)	0.85 (0.63 1.14)	
	S. Tyneside	1.45 (0.98 2.13)	3.15 (2.49 3.99)	
	Sunderland	1.17 (0.69 1.96)	5.51 (4.36 6.96)	
Nitrate	Cleveland	1.00		1.00
	Cumbria	1.33 (0.95 1.87)		1.58 (1.34 1.87)
	Durham	1.19 (0.82 1.73)		1.67 (1.40 1.99)
	Northumberland	2.20 (1.60 3.02)		1.44 (1.22 1.71)
	Newcastle	1.19 (0.85 1.66)		1.42 (1.20 1.67)
	Gateshead & N. Tyneside	1.20 (0.82 1.77)		0.93 (0.75 1.15)
	S. Tyneside	2.25 (1.54 3.28)		2.31 (1.91 2.80)
	Sunderland	1.41 (0.83 2.39)		2.70 (2.18 3.35)
Calcium channel blocker	Cleveland		1.00	1.00
	Cumbria		1.22 (0.95 1.56)	1.41 (1.13 1.75)
	Durham		1.04 (0.79 1.37)	1.10 (0.86 1.40)
	Northumberland		1.96 (1.55 2.47)	1.71 (1.38 2.12)
	Newcastle		1.65 (1.31 2.08)	1.23 (0.99 1.53)
	Gateshead & N. Tyneside		1.23 (0.93 1.63)	1.05 (0.80 1.37)
	S. Tyneside		2.50 (1.92 3.26)	2.03 (1.58 2.61)
	Sunderland		2.78 (2.07 3.75)	2.24 (1.68 2.99)

sponding study practices. Regional estimates were based on the age-sex specific rates from all study practices. The actual numbers of items dispensed, during the year ending 31 March 1993 to all patients registered in the Region were 40–50% higher than the estimated numbers for each of the drug groups (Fig-

ure 4), and well outside the 95% confidence limits. For individual FHSAs the picture was more mixed: in Northumberland the estimated and actual rates were close for both ACE inhibitors and calcium channel blockers; in South Tyneside the actual rate was significantly lower (83%) for ACE inhibitors com-

Figure 4 FHSA prescribing rates 1992–1993. Bars indicate the 95% confidence limits for rates predicted from prescribing in study practices.

*actual rates, derived from PACT data for the entire FHSA.

pared with the estimate based on study practices, and comparable for nitrates; in Sunderland the actual rate for ACE inhibitors was also significantly lower (72%); otherwise the actual (dispensing) rates were higher than the estimates based on prescribing in the corresponding study practices.

Based on prescribing during the calendar year 1992 and OPCS mid-1991 population estimates, the crude prescribing rates for England as a whole were 11.0 items/100 population for ACE inhibitors, 15.3 for nitrates, and 19.1 for calcium channel blockers. Although the corresponding rates in the Northern Region (Figure 4) are higher for nitrates (23.3) and calcium channel blockers (23.5), the rates in study practices are comparable with national prescribing for these two drug groups and distinctly lower for ACE inhibitors.

Discussion

The similarity, for these practice groups, of age-sex profiles of relative prescribing suggests that between different population subgroups, relative prevalences of cardiovascular morbidity and associated therapeutic intervention rates, have little geographic variability. However, there are large differences between practices absolute prescribing rates of ACE inhibitors, nitrates and calcium channel blockers, particularly for hypertension and IHD indications. The magnitude of these differences (up to sixfold) is such that they cannot be explained purely by variation in absolute morbidity levels. Treatment intervention rates must contribute substantially, either through practice differences in overall prescribing for these conditions, or through preferential choice of the three drug groups examined, but the study data do not enable us to say which. Health promotion clinics and screening for hypertension, may lead to higher prescribing prevalences for the same underlying condition, as may local factors such as hospital policies for prescribing and the activity of the pharmaceutical industry.

The decrease in prescribing prevalence amongst the over 75 year olds probably represents a reduced rate of prescribing of these particular drugs rather than any decline in cardiovascular morbidity. Differential rates of age-related decline in usage for ACE inhibitors, nitrates and calcium channel blockers suggest that, for the same indication, practitioners choose a different balance between drugs when treating patients of different ages. The elderly are relatively less likely to receive the newer and more expensive alternative, possibly due to continuation of long-term treatment originating before the newer drugs were introduced or had become standard therapy.

Possible explanations for the higher usage of calcium channel blockers and ACE inhibitors for hypertension in older women, as compared with men of the same age, include differences in morbidity or in the approach to treatment of hypertension in men and women. The third national morbidity survey [9] in

1981, suggests that uncomplicated hypertension morbidity rates are 20–30% higher amongst women than men of the same age and this may in part explain our findings.

Comparison of actual FHSA rates based on items dispensed with estimates based on prescribing in this study must be treated cautiously, but there is evidence that the study practices are not typical of practices regionally. Overall the study practices use less of these cardiovascular vasodilators, although there is considerable variability between the practice groups; South Tyneside and Sunderland groups having distinctly higher rates for all three drug types. If the age-related prescribing profiles (a consistent feature across the study practices) apply to other practices also, then the numbers of items dispensed during 1992–1993 suggest regional prescribing prevalences approximately 40% higher than those observed in the study. This would, for example, indicate that of the population aged 65–74 years, 14% are prescribed nitrates (compared with 10% in study practices), 12% calcium channel blockers and 5% ACE inhibitors. In England as a whole, ACE inhibitor prescribing appears similar to that in the Northern Region, but for nitrates and calcium channel blockers crude rates suggest prevalences similar to the lower rates observed in the study practices.

Prescribing rates in study practices are, in general, lower than the rates for items dispensed to all patients in the corresponding FHSAs. It is highly unlikely that the study population has fundamentally lower levels of morbidity than the rest of the region, and the differences almost certainly represent practice/practi-

tioner influences. The criterion (VAMP research practice) for inclusion in the study was selective of particular types of practice and consequently direct extrapolation to entire FHSAs has to be treated cautiously. Discrepancies between recorded prescriptions and those dispensed to patients may arise from under-recording on practice computer systems, although practices in the VAMP research data bank are reported to achieve 95% recording rates for prescriptions [6]. However, against this must be set the prescriptions issued to patients though never dispensed, which a recent study [10] of primary non-compliance reported at 5.1% overall and 3% for cardiovascular drugs.

In conclusion this study shows consistent age-sex profiles of prescribing for three potential therapies for hypertension, IHD and heart failure. However, there is considerable variation between practice groups in the absolute proportions of patients in each ageband receiving these therapies for indications of hypertension or IHD. Treatment regimens for hypertension have been published [11, 12], but this study suggests that they are not uniformly adopted or interpreted, and in some practices calcium channel blockers and ACE inhibitors are more readily used as first-line treatments. For ACE inhibitor use in heart failure the much lower inter-practice variability is probably due to hospital initiation of prescribing.

We gratefully acknowledge financial support from the Northern Regional Health Authority Research Directorate, and thank VAMP Research Ltd for the provision of data.

References

- 1 Edwards C, Metcalfe D, Burr A, *et al.* Influence of patient age on drug costs: An investigation to validate the prescribing unit. *Int J Pharm Practice* 1991; **1**: 73–78.
- 2 Roberts SJ, Harris CM. Age, sex and temporary resident originated prescribing units (ASTRO-PU): new weightings for analysing prescribing of general practices in England. *Br med J* 1993; **307**: 485–488.
- 3 Sleator DJD. Towards accurate prescribing analysis in general practice: accounting for the effects of practice demography. *Br J gen Practice* 1993; **43**: 102–106.
- 4 OPCS Mortality statistics, DH5 no. 18. London: HMSO, 1991.
- 5 Campbell M, Bateman DN, Smith JM. Analysis of GP prescribing in the Northern Region using PACT data. *Br J clin Pharmacol* 1992; **34**: 184P.
- 6 Jick H, Jick SS, Derby LE. Validation of information recorded on general practitioner based computerised data resource in the United Kingdom. *Br med J* 1991; **302**: 766–768.
- 7 Royal Statistical Society. *The GLIM system, release 4 manual*. Oxford: Oxford University Press, 1993.
- 8 Armitage P, Berry G. *Statistical methods in medical research*, second edition. Oxford: Blackwell Scientific Publications, 1987.
- 9 Morbidity statistics from general practice (1981–2), 3rd national study. MB5 no. 1. London: HMSO, 1986.
- 10 Beardon PHG, Gilchrist MM, McKendrick AD, McDervitt DG, MacDonald TM. Primary non-compliance with prescribed medication in primary care. *Br med J* 1993; **307**: 846–848.
- 11 WHO/ISH HLC. Summary of 1993 World Health Organisation-International Society of Hypertension guidelines for the management of mild hypertension. *Br med J* 1993; **307**: 1541–1546.
- 12 Sever P, Beevers G, Bulpitt C, *et al.* Management guidelines in essential hypertension: report of the second working party of the British Hypertension Society. *Br med J* 1993; **306**: 983–987.