Age and Ageing 2002; **31:** 37–42 © 2002, British Geriatrics Society

Age- and sex-related bias in the management of heart disease in a district general hospital

NIGEL J. DUDLEY[4], ANN BOWLING, MATTHEW BOND, DOROTHY MCKEE, MARIE MCCLAY SCOTT, ADRIAN BANNING[1], ANDREW T. ELDER[2], A. TONY MARTIN[3], IVA BLACKMAN

Centre for Ageing Population Studies, Department of Primary Care and Population Sciences, Royal Free and University College Medical School, Royal Free Campus, London, UK
[1]Cardiology Department, John Radcliffe Hospital, Oxford, UK
[2]Western General Hospital, Edinburgh, UK
[3]Princess Royal Hospital, Haywards Heath, Sussex, UK
[4]Pinderfields Hospital, Wakefield, UK

Address correspondence to: N. J. Dudley. Elderly Services, St James's University Hospital, Beckett Street, Leeds LS9 7TF, UK. Fax: (+44) 113 206 4175. Email: nigel.dudley@leedsth.nhs.uk

Abstract

Objective: to investigate the clinical management of heart disease and determine whether there was age- and sex-related bias in the use of investigations and interventions.
Design: retrospective analysis of individual patient records against criteria of appropriateness based on published guidelines, clinical practice and literature relevant to the 1996–7 study period.
Setting: a single, district general hospital in London, serving a population of 185 000 people.
Subjects: general medical, elderly medical, and cardiology inpatients and patients attending elderly medical and cardiology outpatient clinics as new referrals between 1 April 1996 and 31 March 1997.
Results: we located case notes of 1790 of the 1975 subjects eligible for the study: 911 (51%) were outpatients and 51% were men. Patients aged <75 were significantly more likely than patients aged $\geqslant 75$ years to be given thrombolysis after an acute myocardial infarction, to be given secondary prevention with aspirin and β-blockers, to undergo exercise testing and coronary angiography, and to receive an echocardiogram. Men were also significantly more likely than women to have these investigations and interventions as well as to receive an angiotensin-converting enzyme inhibitor when left ventricular dysfunction was identified. Investigations and interventions were underused at all ages.
Conclusion: as well as identifying age and sex bias, we found the underuse of investigations and interventions in all age groups in this district general hospital. Should similar patterns of care be found elsewhere, the delivery of high-quality care in an equitable manner (as identified by the National Service Framework for coronary heart disease) may require considerably more resources than have been allocated.

Keywords: *age, management of heart disease, sex*

Introduction

The United Kingdom government has indicated that "in a National Health Service there must be a guarantee of excellence for all patients" and "high quality care should be the right for every patient in the NHS" [1]. These aims for heart disease have resulted in the National Service Framework for coronary heart disease [2]. This outlines the provision of effective clinical investigations necessary to establish diagnoses and identify modifiable risks, the application of interventions to prevent death and morbidity, and, where events have occurred, the provision of secondary prevention measures. The delivery of care should be in an equitable manner, regardless of age, sex or ethnicity.

To date, high-quality cardiology services have not been delivered and access has not been equitable. For example, older patients are not referred by general practitioners for investigation of angina, women have not received thrombolysis after myocardial infarction and

economically inactive people and older patients have not had fair access to angiography and other intervention services [3–7].

Resources available for investigations and interventions are finite. The use of guidelines can target those patients most likely to benefit from investigation and intervention. They also help to identify those patients who, having fulfilled specified criteria, do not subsequently receive the appropriate management. The identification of this group allows investigation of discriminatory practices and also highlights possible difficulties in financial or service provision that must be addressed if a high-quality service is to be delivered in an equitable manner.

The aim of our study was to investigate the clinical management of heart disease of patients attending a London hospital by analysing individual patient records against explicit criteria of appropriateness.

Setting, subjects and methods

We carried out the study at a London district general hospital serving a socially deprived population of 185 000 people. We identified eligible subjects for case note analysis from the hospital patient information system and included all inpatients who had a primary diagnosis of heart disease and possible cardiac-related symptoms (Table 1). Diagnoses and symptoms were based on version 10 of the International Classification of Diseases (ICD) [8] (see Appendix 1). All new patients referred to cardiology and elderly medicine outpatient clinics were screened manually. Obstetric patients were excluded.

We included patients attending the hospital between 1 April 1996 and 31 March 1997. The study was carried out retrospectively. Patients in the study were tracked within the hospital for 12 months prospectively and retrospectively from entry and also if they were referred to other hospitals for procedures.

A comprehensive data extraction and coding form was developed by the study group. We agreed appropriateness criteria for investigations and interventions based on clinical practice, published guidelines and literature relevant to the 1996–7 study period through consensus development over the course of five meetings of the research group.

Where appropriateness criteria were based on US guidelines, we used only class I indications recognized as having general agreement (to remove the more subjective elements related to class II indications, which could otherwise have invalidated age group comparisons). For exercise testing, we used the class I indication to assess functional capacity and to aid in assessing the prognosis of patients with known coronary artery disease [9]. For ambulatory electrocardiography, we used the class I to assess symptoms possibly related to rhythm disturbances, including palpitation, syncope and dizziness [10].

We identified patients who would have been eligible for specified investigations or interventions by using combinations of symptoms and investigations that had been recorded on the data extraction forms. Contra-indications to investigations and interventions (including co-morbidities such as peripheral vascular disease, cerebrovascular disease and airways disease) were identified from data recorded on the coding forms. We excluded subjects with contra-indications to particular tests or treatments from statistical analyses.

Statistical analysis

Statistical analyses were carried out using SPSS 9.0 statistical package. χ^2 tests and χ^2 trend tests were used for bivariate data analyses and differences at a minimum level of 5% significance were highlighted. Inter-coder reliability was validated using Cohen's κ.

Results

Eligibility, subjects and diagnoses

We identified case note numbers of 5479 patients for the study. Of these, 1975 were eligible for inclusion. Case notes for 1790 were traced; the remaining 185 (9.4%) could not be located. A total of 3504 cases were found to be ineligible for inclusion: the usual reason for exclusion was over-inclusivity of symptoms screened for to avoid missing eligible cardiac cases (rather than ICD miscoding).

Table 2 shows the age and sex distribution of subjects. The most common diagnoses were heart failure, cardiac conduction disorders and ischaemic heart disease (Table 3).

Other results are presented only for patients eligible for the investigation or intervention being considered.

Table 1. Diagnoses, symptoms and signs used to identify eligibility

Primary diagnosis at discharge or death	Symptoms and signs relevant to possible cardiac disease
Ischaemic heart disease	Unspecified chest pain
Acute myocardial infarction	Breathlessness
Heart failure	Cardiac murmur
Aortic valve disease	Syncope and collapse
Cardiac conduction disorder	Dizziness and giddiness

Table 2. Age and sex distribution of patients

	No. (and %)	
Age, years	Men ($n=911$)	Women ($n=879$)
<65	483 (53)	355 (40)
$\geqslant 65, <75$	219 (24)	170 (19)
$\geqslant 75, <80$	91 (10)	92 (11)
$\geqslant 80$	118 (13)	262 (30)

We also excluded those patients who had co-morbidity contra-indications documented on their coding form.

Coding validation

Hospital ICD coding was validated by researcher's ICD coding from the notes, with good concordance at 80% (Cohen's κ 0.67; 95% confidence interval 0.57–0.77). Inter-coder reliability was tested on a sample of 251 case notes and showed high levels of consistency on recorded data.

Influence of sex and age on treatment and investigations

Acute myocardial infarction

Of the 131 patients who had an acute myocardial infarction, contra-indications to thrombolysis were present in 26, to β-blockers in seven and to aspirin in two. Table 4 shows the frequencies with which various treatments were given. Men were more likely than women to receive thrombolysis for the acute infarct and subsequently to receive secondary prevention treatment.

Table 3. Patients' diagnoses by International Classification of Diseases code

Diagnosis	Code(s)	No. (and %)[a] of subjects
Heart failure	I11, I42, I50, R06	546 (31)
Cardiac conduction disorder	I48, R55, I44, I45, I46, I47, I49, R42, R00	526 (29)
Ischaemic heart disease	I20, I24, I25	447 (25)
Chest pain unspecified	R07	376 (21)
Acute myocardial infarction	I21	131 (7)
Aortic valve disease	I01, I06, I09, I35, R01	130 (7)

[a] Total % exceeds 100 due to multiple responses.

There was a similar age bias in acute and secondary prevention treatments when we compared patients aged <75 with those aged $\geqslant 75$. It appears that many patients did not receive treatment when it was indicated.

Cardiac investigations and interventions (Table 5)

We identified no age or sex bias in the use of 24-h tape recordings. Only 33% of those eligible by the criteria to have a 24-h tape investigation received one.

Men and patients aged <75 were significantly more likely than women and patients aged $\geqslant 75$ to have an echocardiogram. Where left ventricular dysfunction was identified, men were significantly more likely than women to receive an angiotensin-converting enzyme inhibitor. Most patients who were eligible to have an echocardiogram or an angiotensin-converting enzyme inhibitor did not receive the investigation or intervention.

Men and patients aged <75 were significantly more likely than women and patients aged $\geqslant 75$ years to undergo an exercise tolerance test or cardiac catherization study. Only 26% of patients meeting appropriateness criteria to have an exercise test had this procedure and only 54 (17%) of 320 who met the criteria had cardiac catheterization.

Cholesterol testing and statin prescribing in patients with ischaemic heart disease

As Tables 6 and 7 show, there was a decrease in cholesterol testing with increasing age of patients. This was significant on a χ^2 trend test ($P<0.001$). Many of the cholesterol tests were performed in patients who, on the basis of studies and resulting expert opinions, would not have been considered appropriate for statin treatment at that time [11–15].

Multiple regression analyses confirmed that the associations with age and sex in investigations and interventions reported in Tables 4–6 were independent, and

Table 4. Treatments given to patients with acute myocardial infarction (International Classification of Diseases code I21), by sex and age

	No. (and %) of subjects						
		Sex			Age, years		
	All	Men	Women	*P*-value	<75	$\geqslant 75+$	*P*-value
Prescribed thrombolytic							
Yes	40 (37)	30 (45)	10 (27)	<0.05	33 (47)	7 (27)	<0.01
No	65 (63)	37 (55)	28 (73)		37 (53)	28 (73)	
Total	105	67	38		70	35	
Prescribed β-blocker							
Yes	56 (45)	38 (48)	18 (40)	<0.01	46 (53)	10 (26)	<0.01
No	68 (55)	41 (52)	27 (60)		40 (47)	28 (60)	
Total	124	79	45		86	38	
Prescribed aspirin							
Yes	95 (74)	65 (78)	30 (65)	<0.05	70 (80)	25 (59)	<0.01
No	34 (26)	18 (22)	16 (35)		17 (20)	17 (41)	
Total	129	83	46		87	42	

Table 5. Use of cardiac investigations and interventions by sex and age

	No. (and %) of subjects						
		Sex			Age, years		
	All	Men	Women	*P*-value	<75	⩾75	*P*-value
Exercise tolerance test							
Yes	155 (26)	115 (32)	40 (17)	<0.01	148 (33)	7 (5)	<0.01
No	441 (74)	241 (68)	200 (83)		294 (67)	147 (95)	
Total	596	356	240		442	154	
Cardiac catheterization for ischaemic heart disease							
Yes	54 (17)	49 (25)	5 (4)	<0.001	50 (22)	4 (4)	<0.01
No	266 (83)	147 (75)	119 (96)		180 (78)	86 (96)	
Total	320	196	124		230	90	
Echocardiogram							
Yes	222 (41)	123 (46)	99 (25)	<0.001	147 (48)	75 (31)	<0.001
No	326 (59)	147 (54)	179 (75)		159 (52)	167 (69)	
Total	548	270	278		270	278	
Angiotensin-converting enzyme inhibitor for echocardiographically identified left ventricular dysfunction							
Yes	94 (47)	53 (57)	41 (38)	<0.05	53 (51)	41 (38)	n/s
No	107 (53)	40 (43)	67 (62)		51 (49)	56 (62)	
Total	201	93	108		104	97	
24-h tape recording							
Yes	162 (33)	66 (30)	96 (32)	n/s	105 (30)	57 (33)	n/s
No	359 (67)	154 (70)	205 (68)		235 (70)	124 (67)	
Total	521	220	301		340	181	

Table 6. Serum cholesterol tests in patients with ischaemic heart disease (International Classification of Diseases codes I20, I21, I24 and I25)

	No. (and %) by cholesterol measurement		
Age, years	Yes	No	Total
<65	164 (64)	94 (36)	258
⩾65, <75	90 (60)	60 (40)	150
⩾75, <80	25 (44)	32 (56)	57
⩾80	26 (29)	64 (71)	90
All	305 (55)	250 (45)	555

Table 7. Statin prescribing in patients with ischaemic heart disease (International Classification of Diseases codes I20, I21, I24 and I25)

		No. (and %)	
Age, years	Cholesterol, mmol/L units	Prescribed	Not prescribed
<65	⩾5.5	66 (63)	39 (37)
<65	<5.5	31 (53)	27 (47)
<65	⩾5.0	86 (65)	46 (35)
<80	⩾5.0	129 (60)	86 (40)

these have been reported in full in the report submitted to the study's funding health authority.

Discussion

To develop the appropriateness criteria for the study, we used available cardiological guidelines that would have influenced practice in 1996 [9, 10, 16–19]. Decisions in cardiological practice are rarely black or white: the clinical judgement of an individual doctor may be deliberately or subconsciously biased, leading to overt or covert rationing. Attempts to rationalize biased decisions include perceptions of frailty and the consequent inappropriateness for investigations or interventions, and also the deficient evidence base in elderly patients. Studies comparing stenting with surgery have shown favourable outcomes with the less invasive technique for multivessel disease. These and other technological advances suggest that co-morbidities may be less influential on clinical decision-making in the future [20, 21].

The evidence base for cardiological investigations and interventions in elderly patients is sparse compared with that for younger patients because of the failure to include many elderly patients in many trials. However, statins and angiotensin-converting enzyme inhibitors are beneficial, as is bypass surgery—even in octogenarians [22–25]. Lack of evidence does not equate to no evidence. Once appropriate studies have been undertaken, illogical age-based bias may be dispelled [26].

In this study we found that, when the same criteria for investigations and interventions were applied at a standard which removed much of the subjectivity of the decision-making, there were significant age and sex biases. These findings are consistent with those of others investigating the influence of age and sex on the treatment of acute myocardial infarction and secondary prophylaxis (although in the Newham General Hospital study of 1988–94, there was no age bias in the use of aspirin [4, 27]). We have also confirmed significant sex bias in the use of coronary angiography. This has been identified before but, because of lack of clinical data, it

was not felt then to be necessarily evidence of bias [28]. The detailed collection of data on the coding forms in this study and the application of study criteria overcome such reservations.

The unexpected finding in this study was the widespread under-utilization of investigations and interventions in people of all ages. This practice has major implications for the overall standard and quality of care that is delivered. Several explanations could account for, or contribute to, this finding. There may have been a deficiency in the hospital of equipment and staff needed to carry out the investigations.

Alternatively, the clinical practices of doctors within the hospital may have been at variance with the consensus views in guidelines and may have been influenced by perceived ease of access to investigations. For example, a greater percentage of eligible cardiology patients received an echocardiogram compared with eligible general or elderly medical patients.

The introduction of the National Service Framework for coronary heart disease should address resource or clinician issues: there are 12 standards of care to be delivered [2]. Agreed hospital-wide protocols for investigations and management should establish standards of care which will be audited yearly. This should ensure that the National Service Framework eliminates discriminatory practices. Although the framework refers only to audit of the 35–74-year age group, this restriction is reported to have been imposed to ensure consistency of data for audit purposes. The document states that the requirements apply to all people who may benefit, irrespective of age.

There are weaknesses with this study. First it was carried out at a single site. We may have identified an National Health Service trust with a unique approach to the use of cardiological investigations and interventions. Secondly, the guidelines used to inform the appropriateness criteria production were mainly based on US guidelines and literature. This may not be so important, as the National Service Framework coronary heart disease guidelines and standards, and the guidelines for stable angina drawn up by the Royal College of Physicians in 1993 were informed by similar sources. Thirdly, the missing 185 sets of notes, which comprised $< 10\%$ of eligible study subjects, were distributed across the age range and source of entry to the study and could have contained some patients who had been appropriately investigated and treated.

Finally, the study relied on the information documented in the notes, which may not have been complete and may not have been sufficiently explicit in stating why some patients were not treated or investigated.

The major strength of the study was that it was carried out retrospectively. This ensured that clinical practices were not influenced. Therefore, when comparing individual patient records against set criteria, we can be confident about the significance of any age and sex biases identified.

The expectations for healthcare of tomorrow's elderly patients are likely to differ from those of the current older generation: there may be less willingness to stand aside for the young [29]. This and many other studies show under-utilization of cardiological investigations and interventions in elderly subjects. Future demands on healthcare funding may well come as much from the appropriate uses of known technologies as from new developments.

Key points

- In a large London hospital, we found widespread underuse of investigations and interventions for heart disease in all age groups.
- Compared with those aged 75 and over, patients under 75 were more likely to have thrombolysis, aspirin and β-blockade after a myocardial infarction. They were also more likely to undergo exercise testing, angiography and echocardiography.
- Men were more likely than women to have cardiac investigations and treatment (such as echocardiography and angiotensin-converting enzyme inhibitors for impaired left ventricular function).
- If similar patterns of care are found elsewhere, more staff and money will be needed to deliver high-quality, equitable cardiac care.

Acknowledgements

We would like to thank Alison Abery for developing the earlier versions of the coding forms, Lee Marriott, Gillian Hoose, Galia Sperber and the medical students at University College London for their help with coding and data entry, Rosaire Gray for interpretation of the coronary angiograms, the clinicians, trust executives, medical records managers and staff for accessing case notes, and Conor Burke and Age Concern England for suggesting the study.

References

1. Secretary of State for Health. A First Class Service: quality in the new NHS. London: Department of Health, 1998.

2. Department of Health. National Service Framework for Coronary Heart Disease. Modern standards and service models. London: DoH, 2000.

3. Pycock CJ, King A, Marshall AJ. Management of heart disease in the elderly in the Plymouth Health District. J R Coll Physicians London 1995; 29: 15–9.

4. Clarke KW, Gray D, Keating NA, Hampton JR. Do women with acute myocardial infarction receive the same treatment as men. Br Med J 1994; 309: 563–6.

5. Elder AT, Shaw TRD, Turnbull CM, Starkey IR. Elderly and younger patients selected to undergo coronary angiographies. Br Med J 1991; 303: 950–3.

6. Gaffney B, Kee F. Are the economically active more deserving. Br Heart J 1995; 75: 385–9.

7. Pell JP, Pell ACH, Norrie J *et al.* Effect of socioeconomic deprivation on waiting time for cardiac surgery: retrospective cohort study. Br Med J 2000; 320: 15–9.

8. International Classification of Diseases, ICD-10. Geneva: World Health Organisation, 1992–1994.

9. American College of Cardiology/American Heart Association Task Force. Guidelines for exercise testing. J Am Coll Cardiol 1986; 8: 725–38.

10. American College of Cardiology/American Heart Association Task Force. Guidelines for ambulatory electrocardiography. J Am Coll Cardiol 1989; 13: 249–58.

11. Scandinavian Simvastatin Survival Study Group. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). Lancet 1994; 344: 1383–9.

12. Sacks FM, Pfeffer MA, Moye LA *et al.* The effect of pravastatin on coronary events after myocardial infarction in patients with average cholesterol levels. N Engl J Med 1996; 335: 1001–9.

13. Oliver M, Poole-Wilson P, Shepherd J, Tikkanen MJ. Lower patients' cholesterol now. Br Med J 1995; 310: 1280–1.

14. Byrne CD, Wild SH. Lipids and secondary prevention of ischaemic heart disease. Br Med J 1996; 313: 1273–4.

15. Oliver MF. Should we treat hypercholesterolaemia in patients over 65? Heart 1997; 77: 491–2.

16. de Bono DP, Hopkins A. Management of stable angina guidelines and audit standards. J R Coll Phys London 1993; 27: 267–73.

17. American College of Cardiology/American Heart Association Task Force. Guidelines for coronary angiography. J Am Coll Cardiol 1987; 10: 935–50.

18. American College of Cardiology/American Heart Association Task Force. Guidelines and indications for coronary artery bypass graft surgery. J Am Coll Cardiol 1991; 17: 543–89.

19. Working Party of the British Pacing and Electrophysiology Group. Recommendations for pacemaker prescription for symptomatic bradycardia. Br Heart J 1991; 66: 185–91.

20. Rodriguez A, Mele E, Peyregne E *et al.* Three year follow-up of the Argentine randomised trial of percutaneous transluminal coronary angioplasty versus coronary artery bypass surgery in multivessel disease (ERACI). J Am Coll Cardiol 1996; 27: 1178–84.

21. Rodriguez A, Bernardi V, Navia J *et al.* Argentine randomised study: coronary angioplasty with stenting versus coronary artery bypass surgery in patients with multiple-vessel disease (ERACI II): 30-day and one-year follow-up results. ERACI II Investigators. J Am Coll Cardiol 2001; 37: 51–8.

22. Garg R, Yusuf S for the Collaborative Group on ACE Inhibitor Trials. Overview of randomised trials of angiotensin-converting enzyme inhibitors on mortality and morbidity in patients with heart failure. J Am Med Assoc 1995; 273: 1450–6.

23. Pitt B, Segal R, Martinez FA *et al.* on behalf of ELITE Study Investigators Randomised trial of losartan versus captopril in patients over 65 with heart failure (Evaluation of Losartan in the Elderly Study, ELITE). Lancet 1997; 349: 747–52.

24. Dudley N. Lowering cholesterol. J Royal Coll Physicians London 1999; 33: 483.

25. Cane ME, Chen C, Bailey BM *et al.* CABG in octogenarians: early and late events and actuarial survival in comparison with a matched population. Ann Thorac Surg 1995; 60: 1033–7.

26. ISIS-2 (Second International Study of Infarct Survival) Collaborative Group. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. Lancet 1988; ii: 349–60.

27. Barakat K, Wilkinson P, Deaner A *et al.* How should age affect management of acute myocardial infarction? A prospective cohort study. Lancet 1999; 353: 955–9.

28. Kee F, Gaffney B, Currie S, O'Reilly D. Access to coronary catheterisation: fair shares for all? Br Med J 1993; 307: 1305–7.

29. Mariotto A, De Leo D, Dello Buono M *et al.* Will elderly patients stand aside for younger patients in the queue for cardiac services? Lancet 1999; 354: 467–70.

Received 16 October 2000; accepted in revised form 23 July 2001

Appendix 1 International Classification of Diseases (version 10) codes used in the study

I20	Angina pectoris	I45	Other conduction disorders	Q20–25	Congenital heart and valve malformations
I21	Acute myocardial infarction	I46	Cardiac arrest/sudden cardiac death	R00	Abnormalities of heart beat/palpitations
I22	Subsequent/recurrent myocardial infarction	I47	Paroxysmal tachycardia	R01	Cardiac murmurs and other heart sounds
I23	Complications post myocardial infarction	I48	Atrial fibrillation and flutter	R06.0	Dyspnoea
I24	Other acute ischaemic heart diseases	I49	Other cardiac arrhythmias	R07.4	Chest pain, unspecified
I25	Chronic ischaemic heart disease	I50	Heart failure	R09.2	Cardiorespiratory arrest
I35	Aortic valve disease/stenosis	I51	Complications and ill-defined heart disease	R42	Dizziness and giddiness
I42	Cardiomyopathy	I52	Other heart disorders in other classified diseases	R55	Syncope and collapse
I44	Atrioventricular block and LBBB	I70.0	Atherosclerosis of the aorta	R57.0	Cardiogenic shock

LBBB, Left bundle branch block.