

ised trial of intravenous streptokinase, or aspirin, both or neither among 17187 cases of suspected acute myocardial infarction: ISIS-2. *Lancet* 1988;ii:349-60.

3 GREAT Group. Feasibility, safety, and efficacy of domiciliary thrombolysis by general practitioners: Grampian region early anistreplase trial. *BMJ* 1992;305:548-53.

4 Baughman KL, Maroko PR, Vatner SF. Effects of coronary artery reperfusion on myocardial infarct size and survival in conscious dogs. *Circulation* 1981;63:317-23.

5 Bergmann SR, Lerch RA, Fox KAA, Ludbrook PA, Welch MJ, Ter-Pogossian M, et al. Temporal dependence of beneficial effects of coronary thrombolysis characterised by positron tomography. *Am J Med* 1982;73:573-81.

6 Timmis A. Early diagnosis of acute myocardial infarction. *BMJ* 1990;301:941-2.

7 Lee TH, Rouan GW, Weisberg MC, Brand DA, Cook F, Acampora MPH, et al. Sensitivity of routine clinical criteria for diagnosing myocardial infarction within 24 hours of hospitalization. *Ann Intern Med* 1987;106:181-6.

8 Brush JE, Brand DA, Acampora D, Chalmer B, Wackers FJ. Use of the initial electrocardiogram to predict in-hospital complications of acute myocardial infarction. *N Engl J Med* 1985;312:1137-41.

9 Yusef S, Pearson M, Sterry H, Parish S, Ramsdale D, Rossi P, et al. The entry electrocardiogram in the early diagnosis and prognostic stratification of patients with suspected acute myocardial infarction. *Eur Heart J* 1984; 5: 690-6.

10 Rude RE, Poole WK, Muller JE, Turi Z, Rutherford J, Parker P, et al. Electrocardiographic and clinical criteria for recognition of acute myocardial infarction based on analysis of 3 697 patients. *Am J Cardiol* 1983;52:936-42.

11 Short D. The earliest electrocardiographic evidence of myocardial infarction. *Br Heart J* 1970;32:6-15.

12 Rouan GW, Lee TH, Cook EF, Brand DA, Weisberg MC, Goldman L. Clinical characteristics and outcome of acute myocardial infarction in patients with initially normal or nonspecific electrocardiograms (a report from the multicenter chest pain study). *Am J Cardiol* 1989;64:1087-92.

13 Rawles JM. Risk benefit analysis of thrombolytic therapy for acute myocardial infarction: a perspective. *Coronary Artery Disease* 1992;3:1153-61.

14 Wilcox RG. Choice of agent: optimal efficacy vs side-effects. In: de Bono D, ed. *Thrombolysis: current issues and future directions*. Oxford: The Medicine Group (Education) Ltd, 1992:9-15. (MEDICINE Publishing Foundation Series, 31.)

15 Chamberlain DA. Relationship of trials to the general population: who should get thrombolysis and when? In: de Bono D, ed. *Thrombolysis: current issues and future directions*. Oxford: The Medicine Group (Education) Ltd, 1992:17-20. (MEDICINE Publishing Foundation Series, 31.)

16 Schweitzer P. The electrocardiographic diagnosis of myocardial infarction in the thrombolytic era. *Am Heart J* 1990;119:642-54.

17 Essen R, Merx W, Effert S. Spontaneous course of ST segment elevation in anterior myocardial infarction. *Circulation* 1979;59:105-12.

18 Zmyslinski R, Akiyana T, Biddle TL, Shah PM. Natural course of ST segment and QRS complex in patients with acute anterior myocardial infarction. *Am J Cardiol* 1979;43:29-34.

19 Reid D, Pelides L, Shillingford J. Surface mapping of RST segment in acute myocardial infarction. *Br Heart J* 1971;33:370-4.

20 Quyyumi A, Crake T, Rubens MB, Levy RD, Rickards AF, Fox KM. Importance of reciprocal electrocardiographic changes during occlusion of left anterior descending coronary artery. *Lancet* 1986;i:347-50.

21 Gibson RS, Crampton RS, Watson DD, Taylor GJ, Caraballo BA, Holt ND, et al. Precordial ST-segment depression during acute myocardial infarction; clinical scintigraphic and angiographic correlations. *Circulation* 1982;66:732-41.

22 Kleinman E, Sclarovsky S, Lewin RF, Topaz O, Farbstein H, Pinchas A, et al. Natural course of electrocardiographic components and stages in the first twelve hours of acute myocardial infarction. *J Electrocardiol* 1987;20:98-109.

23 Selwyn A, Fox K, Welman E, Shillingford J. Natural history and evaluation of Q waves during acute myocardial infarction. *Br Heart J* 1978;40:383-7.

(Accepted 9 June 1993)

Minor surgery by general practitioners under the 1990 contract: effects on hospital workload

Adam Lowy, John Brazier, Margaret Fall, Kate Thomas, Nicola Jones, Brian T Williams

Abstract

Objective—To determine the extent to which minor surgery undertaken by general practitioners after the introduction of the 1990 contract substituted for hospital outpatient workload.

Design—Before and after observational study.

Setting—Four English family health services authorities.

Subjects—Patients in 22 practice populations who were operated on by their general practitioner or referred to hospital for minor surgery during April to June 1990 or April to June 1991.

Main outcome measures—Numbers of minor surgical procedures undertaken in general practice and in hospital, numbers of referrals to hospitals for conditions treatable by a minor surgical procedure, and the mix of diagnoses and procedures undertaken in each setting.

Results—General practitioners claimed reimbursement for 600 minor surgical procedures during April to June 1990 and for 847 during April to June 1991, an increase of 41%. Referrals to hospital for comparable conditions showed no compensatory decrease (385 during April to June 1990 and 388 during April to June 1991, 95% confidence interval for change in referrals -51 to 57), and the number of hospital procedures resulting from those referrals also remained constant (187 in the first period, 189 in the second, 95% confidence interval for change in procedures -36 to 40). The mix of procedures did not change significantly from one study period to the next in either setting.

Conclusions—Many or all of the additional patients receiving minor surgery under the terms of the 1990 contract may not have previously been referred to hospital. General practitioners seem not to have systematically shifted towards treating the more trivial cases. The overall increase in minor surgical activity may reflect an improvement in accessibility

of care or changes in patients' perceptions and attitudes.

Introduction

Waiting times are shorter and costs to the NHS lower when minor surgery is performed in general practice rather than in hospital.^{1,4} Quality of care, insofar as it has been measured, is broadly comparable in the two settings, and patients' satisfaction with minor surgery performed by general practitioners is universally high.

After many calls for general practitioners to be reimbursed for minor operations,^{1,5,7} the 1987 white paper on primary care recommended such payments on the grounds that "Patients would benefit from a rapid and more convenient service, and minor surgery cases would not take up time in out-patient departments which might be needed for more serious problems."⁸ Item of service payments for general practitioners performing minor surgery were introduced in the 1990 contract to encourage a shift from hospital to general practice.⁹ Since April 1990 general practitioners listed by family health services authorities as willing to perform minor surgery have been entitled to a fee of £20 per procedure for a specified list of minor operations ranging from cauterisation of warts to excision of small lesions.

Two reports have estimated the savings when minor surgery is performed in general practice by extrapolating from calculations of costs in the two settings.^{1,2} Others have pointed out that resources are saved only when a patient who would have been treated in hospital is treated instead in general practice.^{3,4} Whether minor surgery by general practitioners substitutes for minor surgery in hospital or whether it offers a complementary service to patients who would otherwise not have been treated at all has, so far, been explored only superficially. One small study in 1990 observed a

Medical Care Research Unit, Department of Public Health Medicine, Sheffield University Medical School, Sheffield S10 2RX

Adam Lowy, lecturer in public health medicine
John Brazier, lecturer in health economics
Margaret Fall, research associate
Kate Thomas, senior research associate
Nicola Jones, statistician
Brian T Williams, director

Correspondence to:
Dr A Lowy, Department of Epidemiology and Public Health, University of Leicester, Leicester Royal Infirmary, PO Box 65, Leicester LE2 7LX.

BMJ 1993;307:413-7

lengthening of hospital waiting lists for minor surgery when minor surgery by general practitioners increased, although the study was too small for any conclusions to be drawn.³ General practitioners in our area estimated that 84% of their minor surgical procedures represented referrals which had been avoided, although no account was taken of whether demand had increased in response to the greater availability of treatment and no attempt made to determine whether hospital workload had fallen (unpublished report to Trent Regional Health Authority, December 1991). We estimated the extent to which the costs of minor surgery by general practitioners are offset by reductions in hospital workload.

Methods

The introduction of payments for general practitioners to undertake minor surgery was a natural experiment to measure the likely increase in minor operations by general practitioners while monitoring the workload of minor surgery in hospital. We did not use the length of waiting lists for minor surgery as the main outcome measure for hospital workload, as waiting lists respond slowly to changes in demand and are subject to changes in the provision of services. Instead, hospital workload was estimated from the numbers of patients referred for minor surgery in a defined population and from the numbers of procedures resulting from these referrals.

We thought that using referral records held by general practitioners was more efficient than searching through hospital records to find the small group of relevant referrals, and we tested the completeness of general practice records by minor surgical referrals before committing the study to this method. In a sample of 30 cases referred for hospital minor surgery by general practitioners in one of the family health services authorities of the study the referral had been recorded in every case. The maximum likelihood estimate of the proportion of referrals which are recorded is 97% (lower 95% confidence limit 90%),¹⁰ which was considered satisfactory for this study.

All 402 practices with one or more partners registered to perform minor surgery were identified from lists obtained from four family health service authorities in England. Practices were selected at random from this sampling frame. On inquiry, seven practices did not in fact perform minor surgery. These were excluded and replaced by resampling, as were 13 that did not keep records of hospital referrals by name. Nine practices refused to take part and were replaced by resampling. The study sample consisted of 22 practices.

Many general practitioners did not keep records of their referrals until April 1990, when it became mandatory. We wanted to estimate the effect on hospital workload of an increase in the number of minor operations by practitioners, rather than simply to estimate how large that increase was, so a study period before the 1990 contract was not essential. The study periods were April to June 1990 and April to June 1991, between which we expected a substantial increase in minor surgery by general practitioners.

Referrals to hospital for conditions potentially treatable by minor surgery were identified by examining general practitioners' records of all patients referred to dermatologists, rheumatologists, and general, plastic and orthopaedic surgeons during the study periods. Under the 1990 contract general practitioners may be reimbursed only for injections, aspirations, incisions, excisions, and cautery.⁹ Hospital referrals resulting in more complex interventions than these and any requiring an overnight stay or general anaesthesia were excluded.

General practitioners' notes, hospital medical

records, and histopathology records were scrutinised and information collected in each case on the clinical diagnosis and any surgical procedure undertaken. Reasons for no surgical procedure being undertaken in hospital were also collected. All data in the study were coded by a single researcher (MF), who followed a written coding manual. Computer entry and analysis was performed using the Epi-info database and statistical package.¹¹

Results

The number of minor surgical procedures performed by the general practitioners in the study was greater during April to June 1991 than during April to June 1990, but there was no fall in referrals to hospital for minor surgery (table I). The number of referrals was consistently unchanged in each of the five specialties included in the study ($\chi^2=1.4$, $df=5$, $p=0.92$) (table II).

Practices varied widely in the extent to which the number of minor surgical procedures changed, from a fall of 50% to an increase of 1150%. As expected, the seven practices that began minor surgery in response to the 1990 contract increased their surgical workload substantially between April to June 1990 and April to June 1991 (mean increase 102% (95% confidence interval 73% to 131%)). The 15 practices that had performed some minor surgery before the 1990 contract showed a more modest increase (23% (10% to 37%)). Consistently, referrals did not decrease as minor surgery by general practitioners increased: in only two practices was a rise in minor surgery by the general practitioners accompanied by a comparable fall in referrals.

The increase in surgical activity by general practitioners was across all types of procedure (table III). The increases in the numbers of simpler procedures such as curettage, electrocautery, and cryocautery were matched by a comparable increase in the numbers of excisions. The distribution of the types of treatment was not significantly different in the two study periods ($\chi^2=4.92$, $df=5$, $p=0.43$). The mix of procedures carried out in hospital also showed no significant change between the two study periods ($\chi^2=4.05$, $df=6$, $p=0.67$), although in the study as a whole hospital doctors carried out proportionately more excisions and cauterisations and fewer incisions and aspirations than general practitioners (χ^2 for difference in distribution=148, $df=5$, $p<0.0001$). As

TABLE I—Minor surgical procedures performed and referred to hospital by general practitioners from April to June in 1990 and 1991

	Apr-Jun 1990	Apr-Jun 1991	Percentage change
No of minor surgical procedures:			
Performed by general practitioner	600	847	41
Referred to hospital	385	388	1
Total	985	1235	25*

*95% Confidence interval for change in referrals -51 to 57.

TABLE II—Numbers of referrals to hospitals for minor surgery in each specialty from April to June 1990 and 1991

Hospital specialty	Apr-Jun 1990	Apr-Jun 1991	Total
Dermatology	154	163	317
Orthopaedic surgery	88	92	180
General surgery	102	95	197
Plastic surgery	25	26	51
Rheumatology	12	8	20
Missing/not known	4	4	8
Total	385	388	773

TABLE III—Numbers of minor surgical procedures performed in hospital and general practice from April to June in 1990 and 1991 by type of procedure

Procedure	Hospital				General practice			
	Apr-Jun 1990	Apr-Jun 1991	Total	Percentage change	Apr-Jun 1990	Apr-Jun 1991	Total	Percentage change
Injection	22	17	39	-23	196	255	451	30
Aspiration	4	5	9	25	17	31	48	82
Incision	0	2	2	—	57	61	118	7
Excision	85	97	182	14	197	306	503	55
Cautery, etc	75	67	142	-11	107	156	263	46
Other/not known	1	1	2	0	26	38	64	46
None	83	80	163	-4	—	—	—	—
Non-attenders	49	58	107	18	—	—	—	—
Notes unavailable	66	61	127	-8	—	—	—	—
Total	385	388	773	1	600	847	1447	41

TABLE IV—Numbers of minor surgical procedures performed in hospital and general practice from April to June in 1990 and 1991 by general practitioner's diagnosis

Diagnosis	General practice				Hospital			
	Apr-Jun 1990	Apr-Jun 1991	Total	Percentage change	Apr-Jun 1990	Apr-Jun 1991	Total	Percentage change
Warts, etc	100	189	289	89	69	80	149	16
Naevus	40	38	78	-5	31	29	60	-6
Cyst	65	104	169	60	53	70	123	32
Skin tag	40	53	93	33	6	2	8	-67
Abscess	15	23	38	53	1	3	4	200
Benign skin tumour	41	46	87	12	27	20	47	-26
Basal cell carcinoma	1	3	4	200	14	23	37	64
Squamous carcinoma	—	—	—	—	1	1	2	—
Malignant melanoma	—	—	—	—	1	2	3	100
Foreign body, etc	10	14	24	40	5	5	10	—
Laceration	3	3	6	—	—	—	—	—
Ingrowing toenail	27	43	70	59	11	10	21	-9
Musculoskeletal problems*	165	197	362	19	60	67	127	12
Descriptive diagnosis only	20	34	54	70	48	46	94	-4
Other	4	11	15	175	5	12	17	140
Missing/no diagnosis given	69	89	158	29	53	18	71	-66
Total	600	847	1447	41	385	388	773	1

*For injection.

with the mix of procedures, the change in the overall case mix in general practice was not significant ($\chi^2=15.8$, $df=13$, $p=0.2$) (table IV). In particular, there was no consistent tendency for the more trivial diagnoses to increase in relative prevalence.

The numbers of cases referred to hospital for which the general practitioner's diagnosis could not be found was substantially higher in 1990 than 1991 because more of the patients referred in 1990 had moved by the time data were collected, making their general practice records unavailable (13% in 1990, 4% in 1991). This is unlikely to be a source of bias. Among the remaining hospital cases the mix was not significantly different between the two study periods ($\chi^2=11.13$, $df=13$, $p=0.6$) (table IV).

General practitioners in seven of the 22 practices indicated that they began to perform minor surgery because of the changes in the 1990 contract ("new" practices). Referrals did not fall in line with the increase in procedures by general practitioners either in the new practices or in the remaining 15 established practices that had offered minor surgery before the 1990 contract (95% confidence interval for changes in referrals -18 to 48 and -55 to 31 respectively). The distribution of procedures in the two groups of practices differed significantly ($\chi^2=20.83$, $df=5$, $p<0.001$), but new practices did not concentrate on simpler procedures than established practices. Case mix also differed significantly between the two types of practice ($\chi^2=39.22$, $df=13$, $p<0.001$), but new practices did not treat a more trivial mix of cases because compared with the established practices they treated proportionately more warts, ingrowing toenails, naevi, and benign skin tumours.

Only 58% of patients who were referred and whose notes could be scrutinised were treated surgically; a proportion failed to attend outpatient appointments

and a further proportion were reassured or given advice or non-interventive treatment. The likelihood of each of these outcomes did not change significantly from the first study period to the second ($\chi^2=1.01$, $df=3$, $p=0.8$) (figure).

Discussion

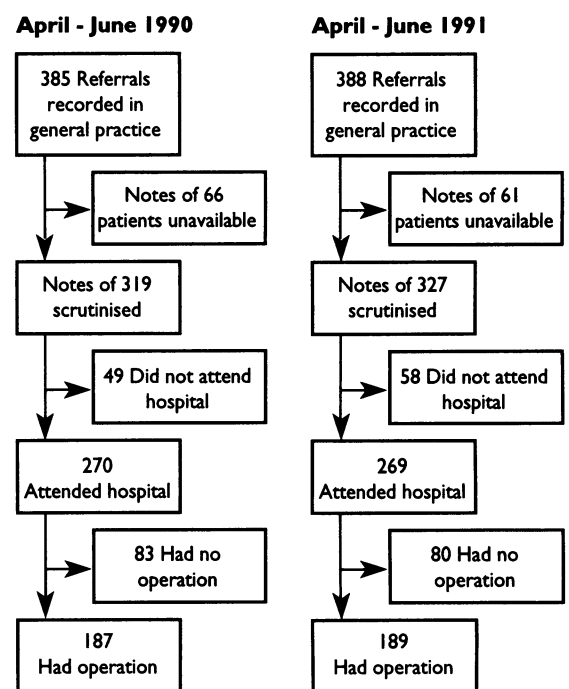
Although we had not aimed at evaluating the impact of the 1990 contract on the numbers of minor surgical procedures by general practitioners, our results show clearly that the introduction of fees was associated with a substantial increase in this service. During April to June 1990 the claims submitted by the general practitioners amounted to 57% of the maximum which could have been claimed under the contractual limit of 15 procedures per general practitioner per quarter. During April to June 1991 claims amounted to 80% of the maximum reimbursable. As the 1990 contract had already begun to influence behaviour during April to June 1990, our result represents a low estimate of the increase in general practitioner minor surgery. Increases were found among practices that had undertaken minor surgery before the 1990 contract, in addition to the increases due to recruitment of new general practitioner surgeons. The fee is clearly sufficient to attract general practitioners to perform minor surgery.

There are several reasons to expect that minor surgery by general practitioners would not substitute for hospital surgery in every case—for example, warts tend to regress spontaneously after a few months and may be treated only if waiting time is short. However, the finding that the number of referrals did not fall at all despite a large increase in procedures by general practitioners was unexpected.

POSSIBLE CONFOUNDING FACTORS

Variation in sampling cannot have made an important contribution as the maximum fall in referrals that is consistent with our data (lower than 95% confidence limit) is 51, only 21% of the observed 41% increase in procedures by general practitioners. Secular trends in the prevalence of disease would also be unable to explain such a large increase in total workload over such a short time.

The total amount of minor surgery performed by



Outcome of hospital referrals

general practitioners may have been underestimated slightly as five of the 22 practices indicated that they perform a few procedures for which no claim is made. The number of referrals for minor surgery may have been slightly overestimated as some referrals for conditions treatable by minor surgery would have been for diagnosis rather than treatment. Neither of these factors, however, could offer an artefactual explanation for the observation that referrals remained constant while general practitioner activity increased.

The overall accuracy of general practitioners' referral records was high. However, a fall in referrals could theoretically have been masked if the general practitioners had recorded minor surgical referrals less conscientiously during the first part of the study than during the second. We therefore examined the numbers of referrals for all reasons other than minor surgery that had been recorded by general practitioners during the two periods. In 14 of the 19 practices where these data had been collected the number of recorded referrals was not significantly higher during April to June 1991, which suggests that referrals were not systematically being missed in the first period. When the analysis was confined to these 14 practices the main conclusion was the same; the number of minor surgical procedures by general practitioners rose by 18% and referrals fell by 3% (95% confidence interval for change in referrals - 21% to 14%, NS). There is thus strong evidence that the main result of the study was not attributable to a systematic improvement in the completeness of recording of referrals.

A second artefact could have arisen if general practitioners who had been planning to introduce or to expand minor surgery services at some time after April 1990 delayed referrals which would otherwise have occurred during April to June 1990, artificially depressing the numbers of referrals made in the first study period. This again could have masked an underlying reduction in referrals between the two periods. However, general practitioners would have had to delay many such referrals to annul our results.

One or both of these artefacts could conceivably have contributed to the observed result. However, the increase in minor surgery by general practitioners was so large that hospital referrals would have had to fall by 64% for the study to have concluded that minor surgery by general practitioners is purely a substitute for hospital activity. Within these practices therefore a large proportion of minor surgery performed under the terms of the 1990 contract is on patients who would not hitherto have been referred to hospital.

REPRESENTATIVENESS

Whether these observations reflect changes in practices throughout England depends on the representativeness of the sample. Our study design excluded practices that did not keep named records of referrals. Such practices (and those refusing to take part) may have differed in some respects from the practices in the sample, so it is possible that the sample was not representative of all practices offering minor surgery. Logically, however, there is no strong reason to suppose that minor surgery by general practitioners in practices which refused to take part in our study or in practices which failed to keep good records of referrals would substitute for hospital referrals to a greater extent than we found in our sample. The principal result, that minor surgery by general practitioners does not always substitute for hospital referral, is robust to even the most extreme assumptions of selection bias. Furthermore, the observation that no substitution occurred at all is consistent with that of McWilliam *et al*, who found that the numbers of skin biopsy specimens taken by hospital doctors have increased since the 1990 contract,

Practice implications

- Waiting times are shorter and costs to the NHS lower when minor surgery is performed in general practice rather than in hospital
- Item of service payments for general practitioners performing minor surgery were introduced in the 1990 contract to encourage a shift from hospital care
- The fee is sufficient to attract general practitioners to undertake a substantial amount of minor surgery
- This study found that minor surgery in general practice does not substitute for hospital referrals
- General practitioners' individual treatment thresholds have not shifted towards more trivial conditions

despite a large increase in the numbers taken by general practitioners.¹³

UNNECESSARY OPERATIONS?

A large increase in total minor surgical workload raises the important question of whether general practitioners are now performing unnecessary operations. Clearly, a great deal more would need to be known about the costs and benefits of minor surgery before this could be answered with certainty.

If general practitioners had lowered their threshold to operate then a shift in their case mix towards less serious lesions would have been expected. Although the diagnostic information was usually available from the general practitioners' notes, the size and severity of lesions were seldom recorded. Information on the seriousness or otherwise of lesions is thus incomplete. However, the diagnostic case mix in general practice changed little between the two study periods. Although the possibility that smaller or less serious examples of each diagnostic type may have been more prevalent in 1991 cannot be excluded, some shift in case mix would be expected to accompany any substantial shift in the general practitioners' overall threshold to operate. The fact that no important diagnostic shift was observed between the two study periods suggests that gross changes in general practitioners' threshold to operate (sufficient to explain a 41% increase in workload over one year) did not occur. This result does not support the suggestion that fees for minor surgery merely provided general practitioners with "a licence to print money."¹²

Excisions cost a practice about the same as the fee and cryocautery costs far less.⁴ Nevertheless, we found no tendency for general practitioners to perform more of the simple procedures than excisions and observed a small (non-significant) shift toward performing the more complex procedures. Similarly, general practitioners new to minor surgery showed no greater tendency than their more experienced colleagues to select the simpler procedures. Therefore the recruitment of new general practitioner surgeons, or the expansion of general practitioner minor surgery as a whole, was not associated with a shift towards performing the simpler and quicker procedures.

The increase in general practitioners' surgical activity cannot be explained to any great extent by their having taken on work which was previously being done in hospital, and it is probably not fully attributable to a drop in their threshold to operate. Reimbursement of costs has probably made it easier for general practitioners to meet needs which they previously did not. In addition, obstacles to seeking treatment have been

removed, principally in the form of long hospital waiting times and the costs of visiting hospital, both identified as inconvenient by patients in a previous study.⁴ Patients' perceptions and attitudes may have changed; they may feel more willing to pursue treatment having consulted their general practitioner, or, having become aware of the possibility that he or she could treat them, may have been more likely to seek help in the first instance. Greater public awareness of the dangers of skin cancer may also contribute.

The 1990 contract effectively gave priority to funding minor surgery by general practitioners up to a theoretical maximum of £31m per year in England, approximately 2% of the general medical services budget. The sum spent in 1991 was estimated as £23m.¹⁴ The consequent expansion of minor surgery in general practice has not been simply a transfer to a more cost effective setting. This result brings into question whether a further expansion would, as has been suggested,¹⁴ necessarily transfer activity from hospital to the community to any great extent. It also raises the question of whether the health benefits from minor surgical activity by general practitioners justify the priority funding.

This study was commissioned by the Department of Health, which, along with Trent Regional Health Authority, funds the core staff of the Medical Care Research Unit. We thank Ms Juliet Brown, Dr Tim Usherwood, and the

general practitioners and hospital doctors who participated in the study. © Crown copyright 1993.

- 1 Brown JS. Minor operations in general practice. *BMJ* 1979;ii:1609-10.
- 2 Coopers and Lybrand Associates. *The cost-effectiveness of general practice; a General Medical Services Committee discussion document*. London: British Medical Association, 1983.
- 3 Coid DR. General practitioner minor surgery facilitated by a Fife district general hospital. *Health Bulletin* 1990;48(3):132-6.
- 4 O' Cathain A, Brazier JE, Milner PC, Fall M. The cost-effectiveness of minor surgery in general practice; a prospective comparison with hospital practice. *Br J Gen Pract* 1992;42:13-7.
- 5 Fry J. General practice surgery—a national need? *Update* 1984;29:293.
- 6 Hunt JH. The scope and development of general practice in relation to other branches of medicine. A constructive review. *Lancet* 1955;ii:681-7.
- 7 British Medical Association. *General Medical Services Committee—report of the New Charter Working Group*. London: BMA, 1979.
- 8 Department of Health and Social Security. *Promoting better health; the government's programme for improving primary health care*. London: HMSO, 1987. (Cm 249.)
- 9 Department of Health, Scottish Home and Health Department, Welsh Office. *General practice in the National Health Service. The 1990 contract. The government's programme for changes to general practitioners' terms of service and remuneration systems*. London: HMSO, 1989.
- 10 Hanley JA, Lipmann-Hand A. If nothing goes wrong, is everything all right? Interpreting zero numerators. *JAMA* 1983;249:1743-5.
- 11 Dean AD, Dean JA, Burton JH, Dicker RC. *Epi-info version 5: a word processing, database and statistics program for epidemiology on microcomputers*. Atlanta: Centers of Disease Control, 1990.
- 12 Shrank A. Counting the cost of eager GPs' minor ops. *Hospital Doctor* 1992 May 21;C12:26.
- 13 McWilliam LJ, Knox F, Wilkinson N, Oogarah P. Performance of skin biopsies by general practitioners. *BMJ* 1991;303:1177-9.
- 14 Boyle S, Smaje C. Minor surgery in general practice: the effect of the 1990 GP contract. In: Harrison A, ed. *Health care UK 1991*. London: King's Fund Institute, 1992.

(Accepted 26 May 1993)

Cryptosporidiosis in infancy and childhood mortality in Guinea Bissau, West Africa

Kåre Mølbak, Niels Højlyng, Adam Gottschau, José Carlos Correia Sá, Liselotte Ingholt, Augusto Paulo José da Silva, Peter Aaby

Abstract

Objective—To investigate the epidemiology of and mortality from cryptosporidiosis in young children in Guinea Bissau, West Africa.

Design—Three year community study of an open cohort followed up weekly.

Setting—301 randomly selected houses in a semi-urban area in the capital, Bissau.

Subjects—1315 children aged less than 4 years.

Main outcome measures—Cryptosporidium infection detected by examination of stools during episode of diarrhoea and death of a child.

Results—Cryptosporidium spp were found in 239 (7.4%) out of 3215 episodes of diarrhoea. The parasite was most common in younger children (median age 12 months) and at the beginning of the rainy seasons. The prevalence of cryptosporidiosis was 15% (77/513) in cases of persistent diarrhoea compared with 6.1% (148/2428) in diarrhoea lasting less than two weeks ($p < 0.0001$). Cryptosporidiosis was associated with excess mortality in children who had the infection in infancy, and this excess mortality persisted into the second year of life (relative mortality 2.9 (95% confidence interval 1.7 to 4.9)). The excess mortality could not be explained by malnutrition, or by socioeconomic factors, hygienic conditions, or breast feeding.

Conclusions—Cryptosporidiosis is an important cause of death in otherwise healthy children in developing countries.

Introduction

The protozoan *Cryptosporidium parvum* has emerged during the past decade as a cause of severe diarrhoea in

immunodeficient patients. Cryptosporidiosis is also recognised as a cause of diarrhoea in otherwise healthy people but the infection is thought to be self limiting.¹ However, associations have been reported between cryptosporidiosis and failure to thrive or malnutrition,¹ persistent diarrhoea,^{2,3} and impaired delayed skin hypersensitivity⁴ in immunocompetent patients, particularly children in developing countries. We conducted a community study to investigate the epidemiology of cryptosporidiosis in a cohort of young children in Guinea Bissau, West Africa.

Subjects and methods

The study was conducted as part of a three year prospective community based surveillance of diarrhoea among children aged below 4 years from a semi-urban district, Bandim II, in the capital of Guinea Bissau.⁵ In brief, all children born after 1 June 1984 residing in a random sample of 301 houses were included in the study, which started on 1 April 1987. Children born in or moving to these houses were also included. Children who moved within the area were followed up from their new houses. Follow up of children born during June 1984 to May 1985 was stopped in April 1988 and of children born during June 1985 to May 1986 in April 1989. A total of 471 children were included when the study started, and the study comprised 1315 children by the end (31 March 1990).

The children were followed up weekly by field workers, who collected information on episodes of diarrhoea during the previous week. If a child had diarrhoea a stool sample was collected later the same day, if possible. A sequence of days with diarrhoea was regarded as one episode of diarrhoea provided that it

Laboratory of Parasitology,
Statens Seruminstitut,
Copenhagen, Denmark
Kåre Mølbak, research fellow
Niels Højlyng, research
fellow
Liselotte Ingholt, public
health nurse

Department of Statistics,
Statens Seruminstitut,
Copenhagen, Denmark
Adam Gottschau, statistician

National Public Health
Laboratory, Bissau,
Guinea Bissau
José Carlos Correia Sá,
technician
Augusto Paulo José da Silva,
coordinator

Epidemiology Research
Unit, Statens
Seruminstitut,
Copenhagen, Denmark
Peter Aaby, senior researcher

Correspondence to:
Dr K Mølbak,
Epidemiology Research
Unit, Statens Seruminstitut,
Artilleivej 5, DK-2300,
Copenhagen S, Denmark.

BMJ 1993;307:417-20