

Middle Articles

Analysis of an Open Electrocardiograph Referral Service for Family Doctors

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Summary: The results of a questionnaire to investigate an open electrocardiograph (E.C.G.) service for family doctors suggest that the service is useful in diagnosis (26% of the E.C.G. reports were unexpected) and in management (the result of the E.C.G. led to specific treatment or alteration to regimen in 22% of cases and in a further 46% to reassurance). The results suggest that during the 45 weeks of the study many outpatient appointments were avoided.

Undoubtedly an open E.C.G. service allows the family doctor to give a quicker and better service to his patients. For this reason and because of operational benefits to the hospital the service must be recommended.

Introduction

Electrocardiograph (E.C.G.) services for family doctors have recently been reported (Lorimer and Kennedy, 1968; Seymour *et al.*, 1968), but many family doctors do not have access to one. Such a service is intended to be of use to the family doctor in diagnosis and management. If it is not available an E.C.G. will either be ordered after a consultation or be arranged by the patient's own doctor if he has access to an E.C.G. machine. Therefore though an open E.C.G. service may produce its own work-load it may divert work from other departments, such as that for outpatients, and it may save family doctors' time and in certain cases expense as well.

This paper sets out to examine these factors by studying the service that has been operating in Exeter for the past 10 years, and attempts to answer the following questions: (1) What work-load does the service impose on the cardiac department? (2) How do E.C.G.s of patients referred by family doctors compare diagnostically with those of medical outpatients? (3) How is the service of use to the family doctor? (4) To what extent, if any, is an open E.C.G. service used in place of other services, such as outpatient departments?

Materials and Methods

The service is used by doctors in the City of Exeter and in the surrounding area extending to 20 miles (32 km.) away. Request cards, which have not altered in design since the

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service began, have sections for blood pressure, drugs, clinical details, and a provisional diagnosis. When a card is received by the department an appointment is made and sent to the patient, and after the E.C.G. has been recorded the doctor receives a photostat copy of the trace, together with a typed report by the consultant or registrar, within 7 to 10 days of making the request. The request cards, together with the recorded E.C.G.s, form the material for this study.

The E.C.G.s from the patients of family doctors recorded over a two-year period were compared diagnostically with a sample of E.C.G.s from medical outpatient departments. Every fourth outpatient referred to the department during 1968 was selected, the last E.C.G. for that patient being chosen for inclusion in the sample. Four diagnostic groups were used and criteria for inclusion in these are shown in the Appendix. In a small number of cases an E.C.G. qualified for inclusion in more than one of the four groups. Any such E.C.G. showing a myocardial infarction was classified under myocardial infarction. Any E.C.G. showing ST-T wave changes with, in addition, a specific abnormality was classified under specific abnormality.

All E.C.G.s were read by one of us (C.M.M.). To check consistency of reporting a sample of E.C.G.s from the patients of family doctors (every fourth E.C.G. filed alphabetically) was reported on again by C.M.M. (Table I). To reduce

TABLE I.

	First reading				Total
	Normal	ST-T	Myocardial Infarction	Other Specific Abnormality	
Normal	157	8	1	2	168
ST-T	1	31	0	0	32
Myocardial Infarction	0	2	32	0	34
Other specific abnormality	3	0	0	50	53
Total	161	41	33	52	287

any memory effect not less than one month elapsed between the two recordings. Seventeen of the 287 E.C.G.s were put in different broad groups on the second occasion.

To aid in assessing how useful the service is to family doctors in diagnosis and management, and to what extent the service is used in place of other services, such as outpatient departments, a questionnaire was prepared (Table II). This inquiry was limited to patients referred between 1 January 1968 and 14 November 1968 (inclusive). During that time 75

family doctors referred 532 patients, seven of whom attended twice, making a total of 539 E.C.G.s. One questionnaire was circulated for each E.C.G. requested. Fifty of the doctors were sent the questionnaire by post, but 25 who had each made seven or more requests were visited by one of us (C.M.M.); 70 (95%) of the doctors co-operated in the investigation. Of the 524 questionnaires that were returned 508 were complete, and these were examined in detail.

TABLE II.—Summarized Results from 508 Completed Questionnaires

(1) Did the patient return to you after you referred him for an E.C.G.?			
Yes	494	97%	
No	14	3%	
	508	100%	
(If answer to question 1 is No, the remaining questions are not answered)			
(2) If this service had not been available would you have referred the patient in any other way?			
(a) Outpatient appointment	350	71%	
(b) Inpatient	8	2%	
(c) Domiciliary	22	4%	
(d) Other	20	4%	
(e) No	94	19%	
Total	494	100%	
(3) Did the result of the E.C.G. lead to a referral?			
(a) Outpatient	28	6%	
(b) Inpatient	5	1%	
(c) Domiciliary	0	0%	
(d) Other	12	2%	
(e) No	448	91%	
Blank	1	0%	
Total	494	100%	
(4) For those patients not referred elsewhere, did the E.C.G. lead to an alteration in your clinical management of the patient?			
(a) Specific treatment or alteration to regimen	111	22%	
(b) Reassurance only	225	46%	
(c) No	112	23%	
	448	91%	
Patients referred elsewhere (see question 3)	46	9%	
Total	494	100%	
(5) Assuming at least the possibility of an abnormal finding, did you expect the actual result obtained?			
Yes	345	70%	
No	127	26%	
Equivocal	22	4%	
Total	494	100%	

Results and Discussion

The total number of E.C.G.s recorded by the department each year has increased from 1,031 in 1958 to 3,860 in 1968 (Table III). Both hospital E.C.G.s and those from the open E.C.G. service have contributed to this increase. The number of E.C.G.s from the open E.C.G. service taken as a percentage of the total number recorded showed a pronounced increase between 1963 and 1965 (from 9.9 to 16.3%), but the proportion has been constant for the past four years.

TABLE III.—Electrocardiograms Recorded each Year from 1958 to 1969

Year	Hospital Inpatients and Outpatients	Open E.C.G. Service	Total	Open E.C.G. Service as a Percentage of Total
1958	938	93	1,031	9
1959	1,187	127	1,314	9.7
1960	1,397	135	1,532	8.8
1961	1,380	100	1,480	6.8
1962	1,519	134	1,653	8.1
1963	1,813	199	2,012	9.9
1964	2,224	295	2,519	11.7
1965	2,032	395	2,427	16.3
1966	2,002	407	2,409	16.9
1967	2,671	494	3,165	15.6
1968	3,164	656	3,820	17.2

The increasing use made of the service has been due not only to a rise in the number of doctors using it but also to an increase in the average number of requests by individual doctors (Table IV). Courses in E.C.G. interpretation for family doctors were held in 1963 and 1964, and these may have stimulated interest, but the increase in subsequent years has been considerable. The number of requests per doctor per annum ranged from 1 to 32.

TABLE IV.—Number of Doctors who have Used the E.C.G. Service each Year Since 1959, and Corresponding Numbers of E.C.G.s Requested

Year	No. of General Practitioners who Used the Service	No. of E.C.G.s Recorded	Average No. of E.C.G.s Recorded per General Practitioner
1959	39	127	3.3
1960	47	135	2.9
1961	37	100	2.7
1962	45	134	3.0
1963	58	199	3.4
1964	64	295	4.6
1965	64	395	6.2
1966	67	407	6.1
1967	70	508	7.3
1968	75	642	8.6

On separating the doctors working in the city from those working in the surrounding area (Table V) it is seen that the increase in the number of doctors using the service is almost confined to those in the city, so that by 1968 87% of them were using the service, compared with only 35% of the doctors outside the city. One of the reasons for this may be that over the past few years E.C.G. machines have become available in smaller hospitals and health centres in the surrounding area. Forty-eight of the 100 doctors now have access to at least nine E.C.G. machines, and these doctors only rarely use the open E.C.G. service. The doctors in the city do not have their own E.C.G. machines.

TABLE V.—Comparison of City and Rural General Practitioners who used the open E.C.G. Referral Service During the past 10 years

Year	City			Rural		
	Total No. of G.P.s who could Use the Service	G.P.s who did Use the Service		Total No. of G.P.s who could Use the Service*	G.P.s who did Use the Service	
		No.	%		No.	%
1959	41	12	29	100	27	27
1960	41	16	39	100	31	31
1961	42	13	31	100	24	24
1962	42	18	43	100	27	27
1963	44	25	57	100	33	33
1964	45	32	71	100	32	32
1965	46	31	67	100	33	33
1966	45	32	71	100	35	35
1967	46	39	85	100	31	31
1968	46	40	87	100	35	35

*This is an estimate.

During 1967 and 1968 1,204 request cards were received. Fifty-four of the appointments made were either not kept by the patient or were cancelled. The number of E.C.G.s recorded per month ranged from 33 to 68. In 78% of the request cards all sections were completed and in only 3% was there no clinical information. The remaining 19% were partially completed, and in most of these no entry was made in the drug section. This section is of particular value with regard to digitalis and diuretic therapy, since these drugs can profoundly alter the E.C.G.

Diagnostic comparison between E.C.G.s from family doctors and those from medical outpatient departments show almost the same percentage of normal traces, but the abnormalities are distributed differently (Table VI). Relatively larger numbers of E.C.G.s from patients of family doctors showed ST-T wave changes or myocardial infarction, which may reflect the large number of patients with ischaemic heart disease being managed by their own doctors. The relatively larger number of E.C.G.s of medical outpatients showing other specific abnormalities may reflect the investigation and follow-up of patients with other kinds of heart disease. Though a

TABLE VI.—Comparison of E.C.G. Reports of Outpatients with those of Patients Referred by General Practitioners

	Outpatients	Patients Referred by General Practitioner
Normal	131 (54%)	615 (53%)
ST-T	26 (11%)	203 (18%)
Myocardial infarction	10 (4%)	119 (10%)
Any other specific abnormality	75 (31%)	213 (19%)
Total	242 (100%)	1,150 (100%)

normal E.C.G. does not exclude heart disease it may at times be of positive help in management. It is interesting to note that Lennon (1969), reviewing the evidence of how family doctors use x-ray departments, concludes that the weight of published information indicates that x-ray films of patients referred by family doctors have a higher abnormality rate than those of patients referred from outpatient departments.

The results of the questionnaire are shown in Table II. The first question asked whether the patient returned to the doctor after referral for an E.C.G. A negative answer meant that the remaining questions were not applicable. This occurred in 14 (3%) instances only. Discussion with doctors indicated that the question was sometimes answered in the affirmative even when the doctor saw the patient at home or spoke to the patient by telephone.

The second question asked whether the patient would have been referred in any other way if the open E.C.G. service had not been available. In 400 (81%) of the cases the service replaced another service—usually the outpatient department. Since only 28 (6%) patients were subsequently referred to the outpatient department as a result of the E.C.G. (question 3), a large number of appointments were probably avoided. The last section of question 2 shows that 94 (19%) patients attending for an E.C.G. would not have been referred elsewhere if the service had not been available. They represent an extra work-load on the hospital, but they probably benefited from the service, since in 65% there was subsequent alteration in clinical management. In 30 cases the doctor said he would have arranged a domiciliary visit or admission to hospital if the service had not been available, suggesting that a few patients are coming to the department when they may not be fit to do so.

In 448 (91%) cases the E.C.G. did not result in a referral (question 3). The family doctor was therefore usually able to continue managing the case himself.

The fourth question asked whether the E.C.G. report led to any alteration in clinical management in those patients not referred elsewhere. In 225 (46%) cases the doctor was able to give reassurance, and in 111 (22%) the E.C.G. report led to specific treatment or alteration in regimen. These results suggest that the service is of use in management. Since outpatient departments are often so busy that the appointments have to be made several weeks in advance, the E.C.G. service may allow decisions concerning management to be made more quickly.

The fifth question was designed to find out how often the E.C.G. report was of help in diagnosis. An unexpected result would be likely to lead to consideration of a different diagnosis. Discussion with doctors indicated that the question was interpreted as asking whether a normal or an abnormal result had been expected. A total of 127 (26%) reports was unexpected, supporting the view that the service is of use in diagnosis. To analyse the distribution of unexpected reports the results of question 5 were compared with the four E.C.G. diagnostic groups (Table VII). An approximately equal number of unexpected reports is found in each group, sug-

gesting that no particular diagnoses are being systematically missed and confirming that E.C.G.s assist in diagnosis.

TABLE VII.—*E.C.G. Report Groups in Terms of Answers to Question 5*

E.C.G. Report	Yes		No		Blank and Equivocal		Total
	No.	%	No.	%	No.	%	
Normal	167	66	72	29	13	5	252
ST-T Wave changes	78	76	21	20	4	4	103
Myocardial infarctions	38	76	11	22	1	2	50
Other abnormalities	62	70	23	26	4	4	89
Total	345		127		22		494

During the study doctors were asked to comment on the service. Several mentioned the possibility of a domiciliary E.C.G. service, which, however, would be difficult in an area where some patients live up to 20 miles (32 km.) away. Many were aware of the operational advantage to the hospital in avoiding outpatient appointments, and some commented that patients are coming to regard an E.C.G. as a routine investigation to be expected in the event of chest pain.

Finally, in assessing the significance of these results it should be remembered that there was a subjective element in the interpretation of the meaning of questions by family doctors. In addition, the answers to question 2 were hypothetical and those to question 5 were partly hypothetical and partly dependent on memory of events.

Appendix

Criteria for Diagnosis of E.C.G. Abnormalities

ST-T Wave Changes.—ST segment deviation from isopotential baseline >1 mm. T wave less than 2 mm. in leads I and V6 in absence of low voltage. Flat or inverted T wave in leads where T wave should be upright.

Myocardial Infarction.—U.S. Public Health survey criteria.

Specific Abnormalities—Left bundle-branch block: QRS >0.12 sec., with slurred wide R wave in V5 or V6. Right bundle-branch block: QRS >0.12 sec., with slurred S wave in lead I and slurred secondary R wave in V1. Left ventricular hypertrophy: SV1 plus RV5 or RV6 >35 mm. Clockwise rotation: SV5 >RV5. Extrasystoles (atrial or ventricular): >1:10 Sinus tachycardia: rate >120 per min., sinus bradycardia: rate <60 per min. Low voltage: limb leads <5 mV, chest leads <10 mV—U.S. Public Health. Left axis deviation: -30° to -90° . Right axis deviation: $>+90^\circ$.

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