

MEDICAL PRACTICE

General Practice Observed

Health Centre X-Ray Unit

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Summary

An analysis of the types and numbers of x-ray films requested in the first year of a health centre x-ray unit showed that chest films represented the largest proportion of these. The unit is most valuable when it is immediately available to the patient and general practitioner at the time of consultation, and thus it should be open for at least five sessions per week. The likely referral rate for the health centre x-ray unit is 84 patients per 1,000 at risk, and a unit functioning for five sessions a week can examine 60 patients during that time. This minimum of five sessions would be fully used by a population of 30,000 patients. The running costs were found to be about the same as those of a hospital x-ray unit.

Introduction

It is now accepted that all general practitioners should enjoy open access to diagnostic radiology, and the early fears expressed by radiologists and others that this might lead to excessive and irrational demands have been discounted.¹⁻³ Nevertheless, the degree of availability varies both in the type of

x-ray examination allowed and in the speed with which patients from general practice are examined. The two main reasons for this restricted access seem to be inadequate facilities and a shortage of staff. When there are such difficulties the x-ray department will give priority to its hospital at the expense of referrals from general practitioners.

In an attempt to improve access it has been suggested that x-ray facilities should be provided in general practitioner diagnostic units or in health centres. The Scottish Home and Health Department are now considering the inclusion of x-ray departments in all health centres serving a population of over 30,000 patients. Where health centres are attached to hospitals x-ray facilities would be available at the hospital, and would not therefore be included in the centre.⁴ Fourteen of the 47 health centres in Scotland now have x-ray units and a further 13 centres attached to hospitals receive their x-ray facilities from the hospital.

We describe here the use made of the x-ray department at Woodside Health Centre, Glasgow during its first year of operation from May 1972 to April 1973.

WOODSIDE HEALTH CENTRE

A total of 22 doctors from eight practices at work at the Woodside Health Centre, which was opened in March 1971 and serves 44,000 people living north of the river Clyde in Glasgow. The greatest density of population, however, lies within a radius of one and a half miles from the health centre. The centre relates to the Glasgow Northern Hospitals Group, particularly to Stobhill Hospital, which provides back-up specialist services to the centre. Each month 28 clinics are held in the centre representing 12 specialties.⁵

X-RAY DEPARTMENT

The x-ray department in the health centre contains a radiography room, a dark room, a viewing room, and a changing room

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with three cubicles. The equipment consists of a 500-mA Machlett Dynamax "48" Diagnostic Tube and an Ilford Rapid "R" Automatic Film Processor. There is no screening equipment and therefore no provision for contrast media or fluoroscopic examinations; patients needing such examinations are referred to Stobhill Hospital or to a general practitioner diagnostic unit in Knightswood Hospital. The department is staffed and financed by the Board of Management, Glasgow Northern Hospitals, and was opened in May 1972 with one part-time radiographer giving four three-hour sessions per week. In September 1972 a second part-time radiographer was recruited to increase the number of sessions to six per week. The sessions are held from 9 a.m. to 12 a.m. on Monday to Friday inclusive and from 1.45 p.m. to 4.45 p.m. on Wednesdays.

All doctors in the centre have open access to the department and may request any type of *x*-ray examination. A standard hospital request card is used and appointments for the department are made in the centre's main office. The films are reported on by a consultant radiologist from Stobhill Hospital who visits the centre each day. The reports are typed and distributed by the centre's audio-typists and both the reports and the films are available to the doctors the next day. The practitioners can see films immediately they are processed and discuss the patient's case with the radiologist. The films are stored in the centre after he has reported on them.

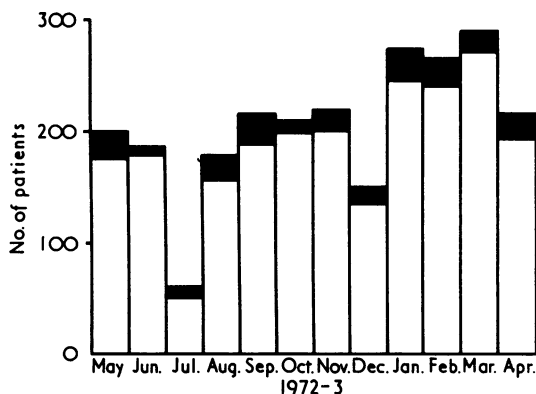
Method

Details of the patient's name, his Woodside serial number, and the examinations requested were collected by the radiographers for each working day since the unit opened. The use made of the unit over its first 12 months was thus accurately covered. Further information, including the doctor's clinical diagnosis, the reason for the *x*-ray request, and the radiologist's report on the film, was obtained from the patient's case record. Information was collected on all patients referred by the general practitioners and the specialists in the centre.

Results

PATIENTS REFERRED

In the first 12 months 2,279 patients were referred by general practitioners, and a total of 2,486 *x*-ray films were taken. Specialists working in the centre referred 173 patients, and a further 200 *x*-ray films were taken for them. The monthly breakdown of the figures are shown in the histogram. The use made of the *x*-ray department varied among the eight practices within the centre (table I). The average rate of referral for the year was 50 per 1,000 patients.



Monthly referrals of patients to *x*-ray unit 1972-3. Shaded area represents proportion referred by specialists.

TABLE I—Usage of *X*-ray Department by Practices over 12 Months

Practice No.	No. of Patients Referred	No. of Patients Registered	Rate per 1,000 Patients
1	287	3,349	85
2	633	6,806	93
3	640	8,654	74
4	266	6,827	39
5	67	3,542	19
6	148	4,609	32
7	120	3,134	38
8	118	6,897	17

X-RAY EXAMINATIONS

The types of *x*-ray examinations were divided into five main categories: (a) arm and shoulder, (b) leg, (c) chest and abdomen, (d) spine and pelvis, (e) skull and sinuses. The total numbers of requests for each category are shown in table II.

The general practitioners' requests for *x*-ray examinations and the radiologists' reports were studied. The reports were divided into those which found nothing abnormal, those that noted an abnormality not related to the reason for the *x*-ray request, and those which reported an abnormality related to the provisional diagnosis. Of the *x*-ray films taken for general practitioners 1,466 (59%) were reported as normal, 523 (21%) showed an abnormality not connected with the *x*-ray request, and 497 (20%) were reported as abnormal and relevant to the reason for the request.

X-ray examinations of chest and abdomen represented the single largest group of examinations (51.6%), and the reasons for and results of chest *x*-ray examinations were studied in detail. The *x*-ray request cards are filed in the health centre by year and alphabetical order, and all requests for chest *x*-ray examinations between 1 May and 31 December 1972 were studied. As would be expected the quantity and precision of the information given by the doctors on the referral card varied. In 18 cases information was missing, but in the remainder it was sufficient to indicate the main clinical problem (586 films; table III).

The report cards of these 586 chest *x*-ray examinations were studied and divided into five groups: 1, negative result; 2, positive result; 3, further *x*-ray examination advised; 4, result not related to provisional diagnosis; 5, resolution of condition stated as request diagnosis. The analysis of the *x*-ray reports is given in table IV.

TABLE II—Number and Type of *X*-ray Examinations requested by General Practitioners

	No.	% of Total	Rate per 1,000 Patients
Arm and shoulder ..	270	10.8	6
Leg ..	345	13.8	8
Chest and abdomen ..	1,285	51.6	29
Spine and pelvis ..	485	19.5	11
Skull and sinuses ..	104	4.3	2

COSTS

An attempt was made to estimate the costs of this service at the health centre and to make a comparison with the expenses of a hospital *x*-ray department. The capital cost of the equipment at the centre was £8,500, and it should have a working life of at least 15 years, thus depreciating at the rate of £556 per year. Radiographer salaries amounted to £2,83p per session, or £781 over the year. The cost of supplies was £774. The regional hospital board is charged by the Scottish Home and Health Department for accommodation used for hospital services in the health centre: the amount payable for the *x*-ray department for the year was £898. The salaries of radiologists and clerks have been omitted from the total as it was not necessary to employ additional staff for these duties. The costs for the year were therefore as follows:

Depreciation on equipment	556.00
Radiographer's salary	781.00
Supplies to department	774.00
Rental of department (including telephones, furnishings, power, heating, lighting, etc.)	898.00
Total	£3,019.00

	Hospital	Health Centre
Number of patients x-rayed	36,000	2,279
Salaries	£12,000.00	£781.00
Supplies	£12,000.00	£774.00
Cost per patient x-rayed	67p	68p

Including the 200 pictures taken at the request of the specialists, the total number of x-ray films taken was 2,686. Thus the cost for each picture taken was £1.12p; the cost for each of the 2,486 films taken for general practitioners was £1.21p.

A detailed assessment of the costs of a hospital x-ray department was also made for the year under survey. While accurate information was available on the cost of salaries and supplies, it was impossible to assess any "rental" for the hospital department, the costs of telephones and electricity, or the depreciation of equipment. The staff of the hospital department consisted of three dark-room technicians, one part-time nurse, three porters, one maid, three orderlies, six clerical staff, and 12 radiographers. The porters, orderlies, and the nurse were almost totally concerned with other areas of the hospital and with patients requiring contrast media examinations.

The total salary bill for the members of staff was £27,182 and the proportion of this that applied to work not using contrast media was estimated at £12,000. The cost of supplies to the department for the year was £27,291 of which £24,000 was spent on x-ray films. Six x-ray films were used for contrast media examinations for every one used for "plain" examinations, and of the 42,000 patients examined during the year 36,000 had non-contrast media examinations. Thus the cost of supplies for examinations other than with contrast media was about £12,000 and the comparable costs for the x-ray departments in the hospital and health centre were therefore as follows:

Discussion

While some areas of the country still have difficulty in obtaining open access to the x-ray department of their local hospital³ the increased rate of the health centre building programme has brought sharply into focus the question of whether x-ray departments should be included in health centres. Many of the views expressed are purely subjective, which is understandable when few such departments exist and when there is little published evidence of their use. From the analysis of figures produced by health centre x-ray units it should be possible to make definitive policy statements on the size of centre which can justify a unit and on the value of it to both patient and doctor.

WORK LOAD

Excluding those needing the use of contrast media the rate of referral for x-ray examinations in this centre was 50 per 1,000 patients over the year. Cook¹ reviewed the first year of an "open door" x-ray department where 2,419 examinations of chest, spine, pelvis, extremities, and skull were done for an estimated 240 doctors. This gave a referral rate of 10 patients per doctor, but as there was no information on the number of patients on their lists a rate per 1,000 patients cannot be given. A referral rate of 10 patients per doctor, is however, almost certainly an underestimate of the usage of x-ray examinations and these doctors probably made use of other hospitals for x-ray referrals.

TABLE III—Analysis of Clinical Conditions and Reasons for Chest X-ray Examination according to Age and Sex

	Age (Years)										Grand Total
	0-20		21-40		41-60		≥61		Total		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
Acute chest infection	8	11	22	9	6	17	8	9	44	46	90
Review of chronic chest infection		1	7	2	10	17	16	12	33	32	65
Exacerbation of chronic chest disease		1			7	4	6	6	13	11	24
To exclude tuberculosis	1		8	5	8	3	1	2	18	16	34
To exclude carcinoma		6	1	2	10	3	7	4	18	9	27
Hypertension	1		2	3	9	12	4	16	16	31	47
Cardiac failure						4	7	16	7	20	27
Congenital heart disease				1						1	1
Chest pain	2	2	21	15	17	19	4	7	44	43	87
"Cough"	3	4	3	3	3	3	2	3	11	13	24
Haemoptysis	2	3	5	5		2	4		11	10	21
Other general symptoms	3	6	14	15	16	22	7	13	40	56	96
Injury			5	3	8	6		1	19	10	29
Routine employment			4	6	2	2			6	8	14
Total	20	34	92	69	96	114	72	89	280	306	586

TABLE IV—Results of 586 Chest X-ray Examinations Percentages to Nearest Whole Number are given in Parenthesis

Reason for X-ray Request	Result Group					Total
	1	2	3	4	5	
Acute chest infection	58 (64)	18 (20)	5 (5)	1 (1)	8 (9)	90
Review of chronic chest infection	30 (46)	32 (49)	2 (3)	1 (2)		65
Exacerbation of chronic chest infection	10 (41)	9 (38)	3 (13)	1 (4)	1 (4)	24
To exclude tuberculosis	27 (79)	2 (6)	5 (15)			34
To exclude carcinoma	18 (67)	3 (11)	4 (15)	2 (7)		27
Hypertension	29 (62)	16 (34)	2 (4)			47
Cardiac failure	9 (33)	15 (56)	2 (7)			27
Congenital heart disease	1 (100)				1 (4)	1
Chest pain	73 (84)	7 (8)	3 (3)	4 (5)		87
"Cough"	22 (92)	1 (4)		1 (4)		24
Haemoptysis	18 (86)		3 (14)			21
Other general symptoms	84 (88)	7 (7)	4 (4)	1 (1)		96
Injury	16 (55)	11 (38)	1 (3)	1 (3)		29
Routine employment	13 (93)		1 (7)			14
Total	408 (69)	121 (21)	35 (6)	12 (2)	10 (2)	586

See text for definitions of result groups

Wallace *et al.*⁶ from a new town practice with a young population described the use made of unrestricted access to a department of diagnostic radiology over a period of three and a half years. A total of 467 *x*-ray examinations, including 86 contrast media examinations, were done, and the average referral rate per 1,000 patients during the final year of this study was 55. The ratio of "plain" to contrast media *x*-ray examinations in Wallace's study was 5:1. If this proportion holds good for the Woodside Health Centre population the Woodside referral rate for all *x*-ray examinations would be 62 per 1,000 patients, which agrees with figures from other studies in comparable populations.^{7 8}

The value of an *x*-ray department in a health centre is partly dependent on the amount of time the unit is open, and this in turn is related to work load. The main advantage of such a unit is that the patient can have his *x*-ray examination while he is at the centre for his consultation and that the family doctor can see the film and obtain a verbal report on the same day. Ideally the unit should be open for five days each week and should cover every consulting period, but if this is not possible the patient should be able to have an *x*-ray examination within 24 hours of the request being made. Thus the unit should be open for at least five sessions per week.

The radiographers in Woodside Health Centre consider that 12 patients is the optimum number that can be examined in a three-hour session assuming that each patient needs only one examination. In theory, therefore, 60 patients would have to be examined each week to achieve full use of the department while it is open. In fact the number of patients examined per session depends on the type and number of pictures taken for each patient and on the time he takes to undress and dress. The referral rate per week during the first eight months of the Woodside unit being opened was variable (see fig.) and averaged 37 patients. Recently, however, the demand has increased and has given an average referral rate of 52 per week.

One year is a short time over which to review the *x*-ray unit as the initial novelty of the department will fade and the way in which it is used may alter as time goes on. Three of the Woodside practices had a referral rate of between 74 and 93 patients per 1,000 over the year (average 84 per 1,000) and the remaining five practices had referral rates of between 17 and 38 (average 29 per 1,000 patients). This indicates two distinct patterns in the use of the *x*-ray unit. Patients have been referred from the centre to the Mass Miniature Radiography Service and to Ruchill Hospital for chest *x*-ray examinations in preference to the centre's unit. At both of these units a daily service is available for chest *x*-ray examination, and they can thus be obtained more rapidly there if a delay builds up in the centre's *x*-ray appointment system. This may have influenced the variability in reference rate among the centre's doctors. Probably a referral rate of 84 per 1,000 patients is closer to the figure that may be expected in the future, particularly as the doctors' experience of using the unit increases.

STAFFING

Attracting staff to the health centre *x*-ray department presented few difficulties; there is a pool of married radiographers in the community to whom part-time work in a health centre is more attractive than work in hospital, which involves emergency and weekend duties. The initial staffing coincided with a time when the hospital department was experiencing a staff shortage and difficulties in recruitment.

X-RAY FILMS REQUESTED

The frequency with which different *x*-ray examinations were requested (see table II) was similar to that reported in other studies,^{1 6 9-12} and the use made of the Woodside Health Centre unit is probably representative of the *x*-ray request pattern for general practice.

The results of examinations in this centre show a different pattern from that found by Wallace *et al.*,⁶ in whose study 34% of *x*-ray examinations (excluding those with contrast media) gave abnormal findings. In our series 41% of the pictures were reported as abnormal but only 20% showed an abnormality significant in the management of the patient.

The analysis of chest *x*-ray pictures showed that 408 (70%) were reported as being normal, 121 (21%) as abnormal, and a further 12 (2%) showed an abnormality not related to the clinical diagnosis given on the request card. When these results are looked at in relation to the clinical information given several comments can be made on the doctor's use of the *x*-ray unit. The term "acute chest infection" implies that clinical examination of the patient has shown signs of such infection, and probably the treatment given has been determined by the history and the physical findings. Of the chest *x*-ray pictures from patients with this diagnosis 20% were reported as showing nothing abnormal, 64% confirmed the clinical diagnosis; neither result would be likely to influence the treatment which had been given. More important were the five instances when further pictures were advised and the eight cases where *x*-ray confirmation of the resolution of infection was reported. The use of chest *x*-ray examination in cases of acute chest infection in general practice should thus be selective as such examinations are more valuable when some other condition—such as an underlying neoplasm—is suspected as contributing to the clinical problem or where *x*-ray proof of resolution of infection is needed.

This argument may also apply to the use of chest pictures in the review of a chronic chest illness and in clinically confirmed exacerbations of chronic chest infection. Of the 89 *x*-ray examinations made with referral diagnoses of "review of chronic chest infection" and "exacerbation of chronic chest infection" about half were reported showing nothing abnormal (see table IV).

Of the 87 *x*-ray pictures requested with an unspecified diagnosis of "chest pain" on the request card seven were reported as showing evidence of infection. It may be argued that this would put these *x*-ray requests into the same category as those with a diagnosis of "acute chest infection;" this also applies to the 24 instances when the clinical information was simply "cough." Probably, however, in some of these patients the doctor wanted to exclude either a carcinoma or tuberculosis.

Of the 586 chest *x*-ray films requested between May and December 1972, 320 (54%) could probably be fully justified. Some of the remaining requests may have been influenced by the availability of the *x*-ray service and are therefore open to question. The analysis of the reasons for and results of *x*-ray examinations, however, will enable the doctors using the health centre service to be more objective and selective. This is perhaps over-critical as in many instances the referring doctor did not state precisely his objective in requesting the *x*-ray examination. Possibly the doctor's wish to reassure his patient often prompted the use of an *x*-ray examination not apparently fully justified clinically. The patient himself takes the card to the *x*-ray department and this in itself can modify the information that the doctor writes on the card. On the *x*-ray request cards 13 items of administrative information have to be completed in addition to the diagnosis and clinical notes. There is a need for a combined *x*-ray request and report form which includes only essential administrative information and which has space for the doctor to state the primary diagnosis and his reasons for the request. Such a card is at present being developed, and will enable a more accurate and meaningful assessment of the general practitioner's use of *x*-ray examinations.

VALUE OF THE UNIT

While all general practitioners should have access to diagnostic radiography the provision of a health centre *x*-ray department has been described as an expensive luxury. Steiner¹³ wrote, "A satisfactory and economical radiological service can only

be provided by general hospitals. Dispersal of such a service to outside clinics and health centres must be avoided in future planning."

To the patient the ability to have an *x*-ray picture taken in the centre immediately before, during, or after, a consultation is of value both in saving time and in the speed with which he can be told the results of the examination. To the family doctor the immediate availability of the department in the centre means that more rapid progress can be made both in diagnosis and in patient management. It is one of the factors which increases "job satisfaction". The health centre department allows the general practitioner to see *x*-ray pictures after they have been processed and to discuss them in greater detail with the radiologist when he is reporting on the film. He thus can become more aware of the values and limitations of *x*-ray diagnosis and can become more confident at interpreting films before they have been formally reported. The term "allows" is used specifically because personal consultations between the referring doctor and the radiologist have unfortunately been infrequent. The most likely reason for the lack of contact is the difficulty many general practitioners find in being available during the limited time when the radiologist is in the centre.

These advantages will only accrue if the patient can have his *x*-ray examination at the time of his consultation. An objection to installing expensive equipment in a health centre is that it will be idle for part of the day if used part time or full time with a suboptimal patient load. On the basis of the current radiographers' salaries the additional cost of keeping the health

centre unit open for 10 sessions per week would be £690. If the annual referral rate seen in the first year of this unit remains steady with the unit open for 10 sessions the total cost of the department would be £3,709. The cost per *x*-ray film would then be £1.49p (or 90p if only supplies and salaries are included in the costs). Despite the increase in costs and despite the patient referral rate being lower than that which the radiographers consider as being optimum there is a strong case for the health centre unit being open for five days weekly.

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Contemporary Themes

Speedboat Propeller Injuries

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Summary

Six patients are reported who were severely injured by high-speed boat propellers. With reasonable precautions such accidents need never occur, and people should be more aware of these and ensure that safety measures are enforced.

Introduction

People may be injured during water skiing by contact with the boat or skis, by entanglement with the rope, by collision with obstructions in the water, or even by hard falls into the water at speed. The acceleration associated with "dock starts" can also produce less severe injuries. The mechanisms of water skiing injury have been discussed by McCarthy.¹

With the increasing emphasis being laid on leisure all sports, and especially water sports, are becoming more popular so the number of injuries is likely to increase. Of all injuries those caused by the propeller can be the most severe. This paper describes six patients injured by high speed boat propellers

Not all the patients were engaged in water skiing but the injuries could be similar. It is hoped that by publicizing these cases awareness of danger may attract greater safety consciousness.

Case 1

While this man, aged 29 years, was pushing a boat off a sandbank the engine fired. The boat passed over him causing 15 lacerations across the back, one of which transected the sacrum exposing the rectum. He also sustained severe lacerations of the left popliteal fossa, the left lower leg, and a compound fracture dislocation of the right ankle (fig. 1).

His left leg was amputated below the knee. Reduction and debridement of the right ankle were performed. The back lacerations, several of them deep, were sutured. The sacral segments were opposed with monofilament nylon. As the rectum was bruised a transverse colostomy was performed.

A year later he was well and walking satisfactorily on his prosthesis though the right ankle was not completely healed because of osteomyelitis. A small area of anaesthesia on the saddle area was not a great disability. Sphincter control was normal.

Case 2

This 27-year-old woman fell while water skiing in the late afternoon. While returning to pick her up the driver was dazzled by the setting sun reflected from the sea and ran over her. She sustained a compound comminuted subtrochanteric fracture of the right femur through a buttock laceration. She also had deep lacerations of the left thigh, left