Ward based X-ray facilities can improve services

ABSTRACT—As part of a wider experiment, a satellite X-ray facility, run by 2 part-time radiographers (1 whole time equivalent), was established to provide all plain radiographs on inpatients in a patient focused unit of 114 beds created from 4 medical wards of a 370-bed district general hospital providing acute services to a local population of about 200,000. Fewer staff were needed to provide an X-ray and report on the ward, the number of steps was reduced from 54 to 42 and the time taken from 104 to 62 minutes. Radiographers spent a smaller proportion of their time on professional duties but freed up substantial time for other members of staff. The reactions of all involved, staff and patients, were favourable. With present technology, the patient focused approach brings net benefits and possibly decreases costs, but the balance may swing back to centralisation when picture archiving and communication systems (PACS) become more widely available.

For the past 20 years radiological services have become increasingly centralised, in line with government recommendations [1]. As hospitals have widened the scope of their services and embraced new technologies the size of these departments has grown and the procedures involved in even a routine task such as obtaining an inpatient chest X-ray have burgeoned. Eleven members of staff were needed to obtain a simple chest X-ray at one hospital [2]. The chance of process failure increases with the number of steps. The most efficiently run department finds the delivery of a top quality service thwarted by failures beyond its control, for instance in portering or on the wards. As pressure on beds mounts, delays and uncertainties must be minimised.

We compare our experiences with a central X-ray department and a ward based facility commissioned as part of a patient focused care initiative [3]. By eliminating many of the steps and giving responsibility for coordinating the complete process to ward based radiographers, we aimed to produce a faster, more reliable service.

Methods

Kingston Hospital is a district general hospital with 370 inpatient beds. The central X-ray facility is three levels below, and approximately 200 m of corridor away from, the 114-bed medical unit where a ward based X-ray facility has been established.

T D HEYMANN, MBA, MRCP, *Senior Registrar, Department of Gastroenterology, Royal London Hospital, London*

W CULLING, MD, FRCP, *Consultant Physician, Department of Medicine, Kingston Hospital NHS Trust, Surrey*

The process of obtaining inpatient chest X-rays from the central facility was tracked from the point at which a request was made by a physician to the point when reported films were available on the ward and received by the physician. Each step in the process was timed separately and interviews were held with the staff involved. The resulting flow chart was discussed with staff and amended where necessary. The observations and discussions were repeated after the ward based X-ray facility was established. In both cases multiple observations were made over the course of a week. The flow charts were compared. It was assumed that old films had previously been pulled and were available on the ward and that complete X-ray packets with the new films were returned to X-ray for filing after discharge in the same way, whether the central or ward based facilities were used.

Results

Table 1 shows the flow of activities and the staff needed when the central X-ray facility is used to obtain routine chest X-rays on medical inpatients. The 10 members of staff altogether undertake 54 distinct activities of which only 10 require a degree of medical, technical or clinical (MTC) expertise. The responsibility for the process is passed on 18 times—from doctor to ward clerk, to radiology coordinator, to porter, and so forth. The activities themselves require almost $1^{3}/_{4}$ hours of staff time to complete; $1^{1}/_{2}$ hours (82%) is spent on the process rather than performing the MTC aspects of obtaining an X-ray. The elapsed time between collecting patients from their beds and returning them could be several hours.

Table 2 illustrates the same process when the ward based X-ray facility is used with that facility's radiographer in overall control of the process. The number of people necessarily involved drops to 5; the radiology coordinator, X-ray receptionist, porter, filing and ward clerks are no longer vital links in the chain. The number of distinct activities is reduced to 43. A quarter of the process steps are eliminated and many of those that remain are shorter owing to the proximity of the X-ray facility to the patients. Time saved in staff movement and patient transport alone exceeds 30 minutes per patient. The responsibility for seeing the process through changes hands only 9 times, a 50% improvement. Without the disruption of scheduled work, films requested early on a ward round can be available before the round ends.

The radiographers on the ward based unit have greater patient contact but spend only 19% of the time on MTC activities whereas their colleagues in the

Table 1. Time taken to obtain an X-ray from the central facility

Step	Activity	Staff member responsible	Time taken hh:mm:ss
1	Complete request form	Doctor	1:30
2	Leave form with ward clerk	Doctor	0:15
3	Take request form to radiology department	Ward clerk	3:00
4	Hand in request form at X-ray reception	Ward clerk	0:30
5	Return to ward	Ward clerk	3:00
6	Sort requests	Radiology coordinator	0:30
7	Monitor/schedule X-ray slot	Radiology coordinator	3:00
8	Check patient availability	Radiology coordinator and ward clerk or nurse	3:00
9	Request in patient slot	Radiology coordinator	0:30
10	Dispatch porter	Radiology coordinator	1:00
11	Travel to ward with chair	Porter	7:00
12	Retrieve X-rays from notes trolley	Ward clerk	1:30
13	Locate and verify patient	Porter and nurse	1:30
14	Move patient from bed	Porter and/or nurse	4:00
15	Transport to X-ray	Porter	7:00
16	Hand in films	Porter	0:30
17	Check details	X-ray receptionist	2:00
18	Enter data	X-ray receptionist	2:30
19	Put request form in designated slot	X-ray receptionist	0:15
20	Take request form to designated X-ray room	Radiology coordinator	1:00
21	Travel to patient waiting area	Radiographer	0:30
22	Identify patient	Radiographer	1:00
23	Take patient to designated X-ray room	Radiographer	1:00
24	Put name ID in chest changer	Radiographer	0:15
25	Position patient	Radiographer	3:00
26	Set machine	Radiographer	2:00
27	Take X-ray	Radiographer	0:15
28	Reseat patient	Radiographer	1:00
29	Auto film processing		
30	Check X-ray quality	Radiographer	2:00
31	Number film and detail packet	Radiographer	1:30
32	Countersign request form	Radiographer	0:15
33	Put films out for transport to X-ray sorting room	Radiographer	0:30
34	Post patient's name as ready for return to ward	Radiographer	2:00
35	Identify patient for return to ward	Porter	1:00
36	Return patient to ward	Porter	7:00
37	Move patient into bed	Porter and nurse	4:00
38	Return to radiology	Porter	7:00
39	Take films and request forms to be reported to X-ray sorting room	Porter	1:00
40	Marry up request forms and films	Filing clerk	2:30
41	Sort films by date	Filing clerk	0:30
42	Sort films by request	Filing clerk	0:30
43	Place into in patient slot for reporting	Filing clerk	0:15
44	Collect films for reporting	Filing clerk or secretary	0:30
45	Read films	Radiologist	4:00
46	Dictate report	Radiologist	1:30
47	Type report and sort copies	Secretary	4:00
48	Validate report	Radiologist	1:00
49	Place packet in ward slot for collection	Secretary	0:15
50	Take packet to ward	Porter	1:00
51	Refile packet in notes trolley	Ward clerk	2:00
52	Retrieve packet from trolley and find latest films	Doctor	2:00
53	Read films	Doctors	4:00
54	Refile films on ward	Doctor or ward clerk	1:30
	TOTAL		1:44:15

Times stated are averages and apply per patient when several patients' films are handled simultaneously

central department use their MTC skills for almost half of the time that they spend obtaining each chest X-ray (Table 3).

The quality and safety guidelines in the ward based unit were identical to those in the central department.

Discussion

Many stakeholders have been affected by the establishment and use of the ward based X-ray facilities—the users, physicians and patients, the radiographers and the finance department.

User's perspective

Patients on Kingston Hospital's medical unit no longer need to be absent from the ward for long periods when plain X-rays are requested by their physicians. Trips down draughty corridors and waits in a busy central department have been eliminated. Patients need only meet one new professional, the radiographer, rather than a succession of unfamiliar members of staff. The ward based radiographer collects the patient from his or her bed and without interruption organises and takes the X-ray picture, then returns the patient to the ward area.

Without the handovers that characterise the process through the central department, the elapsed time for the process is little more than the sum of the times for the individual steps. Patients receive a swifter, more personal service, as do the requesting physicians; turnround times from requesting a film to receiving it are shorter.

For sick patients who cannot safely be transported to the central department, the availability of the ward based facility eliminates the need to use portable equipment with the attendant risk of radiation exposure to other patients. Few patients on a general medical ward are too sick to be wheeled in their beds to the ward based facility, and nursing staff do not have to accompany them. Resuscitation equipment remains close at hand. The quality of the films from the fixed installation is likely to be higher than would be possible with a portable machine [4].

Some of the these benefits could have been achieved without a ward based facility. On-line X-ray requesting would be likely to improve tracking, simplify scheduling and reduce paperwork. Electronic picture archiving and communications systems (PACS) [5] would help not only to 'distribute' reported films but also to guide radiographers to take further views when necessary. 'Hot reporting' is said to reduce elapsed time if not reduce the process steps [6]. Voice recognition systems for writing the reports could reduce delays and process steps by eliminating the secretarial work. However, the problems of transporting patients to and from the distant department would remain. The cost and reliability of the new technologies remains uncertain.

Radiographer's perspective

The radiographers who were specifically employed for the new ward based role identify closely with the staff and patients on the medical unit. Their working day differs from that of colleagues in the central department in that they have greater patient contact and a more personal relationship with other ward staff and the requesting physicians. They trade off participation in more complex radiological procedures for greater responsibility in seeing through the request to reported film process and the chance to become involved with other patient-related activities such as endoscopy.

Not all radiographers would enjoy such a challenge but we believe that it must be in the interests of any professional group to offer as wide a range of job options as possible to meet individual preferences and abilities. We envisage that holders of these posts could in future rotate through the central department, with which a close professional relationship remains. The posting exposes radiographers to the priorities of other health professionals and helps to increase understanding of each other's needs. The concentration of inpatient work may be helpful for training purposes although the lack of professional colleagues in the immediate vicinity may limit possibilities here.

The argument that it is wasteful for highly trained radiographers to spend time on non-MTC tasks [7] may not stand up to detailed scrutiny. It ignores the time that radiographers in the central department spend coordinating the activities of others or waiting for somebody else to complete an activity before they can start their own [8]. The ward based radiographers are much freer than their central department colleagues to organise their time and prioritise their work.

Financial arguments

Central units have been developed on the commonly held belief that expensive equipment needs to be fully utilised [9]. In our ward based facility, equipment costs (capital and maintenance) are certainly higher on a per film basis than in the central department. Although the service development we describe should be judged on its quality improvements, acknowledged by the Audit Commission [10], we calculate that an average throughput of only 11 patients a day makes the arrangements cost-neutral. In effect the salary of a porter is saved and can be offset against higher capital charges and maintenance costs, although the cost argument is clearly more complex than this. It is assumed that the ward based radiographers contribute fully to other unit activities when not in their radiographer role. The cost savings ignore the value to the unit of an occasional earlier discharge made possible by the presence of the X-ray facility, the saving on nursing time previously needed to accompany sick patients to the central department, the lost time of

Table 2. Time taken to obtain an X-ray from the ward based facility

Step	Activity	Staff member responsible	Time taken hh:mm:ss
1	Complete request form	Doctor	1:30
2	Drop off request form at satellite radiology facility	Doctor	0:30
3	Sort requests	Radiographer	0:30
4	Check patient availability	Radiographer with or without nurse/auxiliary	3:00
5	Travel to patient's bed with chair	Radiographer	1:00
6	Retrieve X-rays from notes trolley	Radiographer	1:30
7	Locate and verify patient	Radiographer with or without nurse/auxiliary	0:30
8	Move patient from bed	Radiographer with or without nurse/auxiliary	4:00
9	Transport to radiology room	Radiographer	1:00
10	Enter data	Radiographer	2:30
11	Position patient	Radiographer	3:00
12	Set machine	Radiographer	2:00
13	Take X-ray	Radiographer	0:15
14	Reseat patient	Radiographer	1:00
15	Auto film processing		
16	Naming of film	Radiographer	0:15
17	Check X-ray quality	Radiographer	2:00
18	Number film and detail packet	Radiographer	1.30
19	Countersign request form	Radiographer	0:15
20	Replace packet by patient	Radiographer	0:15
21	Return patient to patient's bed	Radiographer	1:00
22	Move patient into bed	Radiographer with or without nurse/auxiliary	4:00
23	Refile films in notes trolley	Radiographer	1:30
24	Return to radiology room	Radiographer	1:00
25	Retrieve packet from trolley and find latest films	Doctor	2:00
26	Read films	Doctors	4:00
27	Refile films on ward	Doctor	1:30
28	Collect films to be reported from notes trolley	Radiographer	1:00
29	Marry up request forms and films	Radiographer	2:00
30	Sort films by date	Radiographer	0:30
31	Sort films by request	Radiographer	0:30
32	Take films and request forms to sorting room in radiology department for reporting	Radiographer	1:00
33	Return to ward area	Radiographer	1:00
34	Collect films for reporting	Secretary	0:30
35	Read films	Radiologist	4.00
36	Dictate report	Radiologist	1:30
37	Type report and sort copies	Secretary	4:00
38	Validate report	Radiologist	1:00
39	Place packet in ward slot for collection	Secretary	0:15
40	Go to department to collect films	Radiographer	1:00
41	Collect reported films and return to ward area	Radiographer	1:00
42	Refile packet in notes trolley	Radiographer	1:30
	TOTAL		1:02:15

Times stated are averages and apply per patient when several patients' films are handled simultaneously

other staff who visit to find a patient absent in the central department, and so forth. Of topical interest is the time that the arrangements save junior medical staff by providing a single, human, ward based interface with the central department—the ward based radiographer.

Potential pay-offs to the central department may accrue in due course too. Although it loses some units

Table 3. Comparisons of time spent obtaining a chest X-ray from different facilities

Staff member	Central facility (min)*	% MTC†	Satellite facility (min)*	% MTC†	Time saved (min)
Doctor	8.50	47	8.75	46	–0.25
Filing clerk	4.00		0.00		4.00
Nurse/auxiliary	5.75		2.88		2.88
Porter	36.25		0.00		36.25
Radiographer	15.25	49	38.88	19	–23.63
Radiologist	6.50	100	6.50	100	0.00
Radiology coordinator	7.00		0.00		7.00
Secretary	4.50		4.75		–0.25
Ward clerk	11.75		0.00		11.75
X-ray receptionist	4.75		0.00		4.75
Total	104.25	17	61.75	29	42.50

* All times are averages
† MTC: medical, technical and clinical

of work, it benefits from being able to focus on outpatient and general practitioner generated workloads and complex examinations.

Conclusion

The benefits to inpatients of Kingston Hospital's ward based X-ray facility, in terms of timely, hassle-free diagnostic tests and lack of exposure to radiation scatter from portable X-rays aimed at other patients, are significant. Physicians receive a faster, more reliable service. Radiographers have a new job option. Film quality and safety standards are maintained and, in comparison with the occasionally used portable, improved.

Our findings re-emphasise the value of considering capital versus revenue cost trade-offs as commended in NHS project appraisal literature [11]. For the organisation to benefit, departments need to consider the revenue implications to others of their own capital spending decisions. Accounting mechanisms need to be in place to allow one department to make a greater capital spend to provide others with recurring revenue savings.

The model of a central department focused on complex examinations and outpatients, complemented by ward based facilities and staff to satisfy the need for plain inpatient X-rays, may have wider application, though the greater affordability of new technologies such as PACS may tilt the balance back towards centralisation in the future.

References

1 Department of Health and Social Security. *Management arrangements for the reorganised National Health Service.* London: DHSS, 1972.
2 Black A, Garside P. Patient focused care: Health Service Journal health management guide. *Health Service Journal* 1994;23 June.
3 Heymann TD, Culling W. The patient focused approach: a better way to run a hospital? *J R Coll Physicians Lond* 1996;**30**:142–4.
4 Eisenberg RL, Akin JR, Hedgcock MW. Optimal use of portable and stat examination. *Am J Roent* 1980;**134**:523–4.
5 Hruby W, Mosser H, Urban M, Ruger W. The Vienna SMZO PACS project: the total digital hospital. *Eur J Radiol* 1992;**16**:66–8.
6 James MR, Bracegirdle A, Yates DW. X-ray reporting in accident and emergency departments: an area for improvements in efficiency. *Arch Emerg Med* 1991;**8**:226–70.
7 Janower ML. Patient focused care: radiology departments beware. *Radiology* 1993;**187**:313–4.
8 Lee GL, Clarke RW. Restructuring improves hospital competitiveness. *Healthcare Financial Management* 1992;November:31–7.
9 Doshoki A. Viewpoint. *Hospital Doctor* 1992;10 December.
10 Audit Commission. *Improving your image: how to manage radiology services more effectively.* London: HMSO, 1995.
11 *Investment appraisal guidance notes.* Leeds: Department of Health, 1993.

Address for correspondence: Dr T D Heymann, Senior Registrar, Department of Gastroenterology, Royal London Hospital, London E1 1BB.