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Guest Editorial

Cutting work at the cutting edge

Stephanie McWilliam

Plymouth Oncology Centre, Derriford Hospital, Plymouth, UK

INTRODUCTION

The Plymouth Oncology Centre was relocated from the older, inner city hospital of Freedom Fields to the District General Hospital, Derriford almost 2 years ago. In the process, an unusual opportunity developed to look critically at existing work practices for two main reasons. Firstly, a change in government policy during the planning process determined that the equipment should be acquired under a private finance initiative.[1] The end result was an operating lease and a need to link staffing and equipment costs to help make the equipment affordable. Secondly, delays in the move meant that all the equipment could be written-off. It is very rare for a radiotherapy service to be able to 'start from scratch' with all new equipment (except the superficial and brachytherapy units). The result is a much more efficient service; taking 'fractions delivered per treatment radiographer' as the measure, efficiency improved by 70% in the first year of operation in the new department (from 2157 to 3676. Regional average 2250). An obvious concern was that the quality of patient care may be compromised. However, there is no evidence to support this and user feedback results suggest that the quality of care may well have improved.

THE THREE ESSENTIAL ELEMENTS

Reflecting on these changes, it is now apparent that there are three main and interconnected reasons for the outcomes. The first is the staff profile. Without a doubt, none of this would have been possible without an extremely competent, open-minded and confident team of professional staff. The second is the equipment, with all the advantages that new technology can provide. The third is the design of the building, which enables the changes in work practices to be implemented fully (Fig. 1).

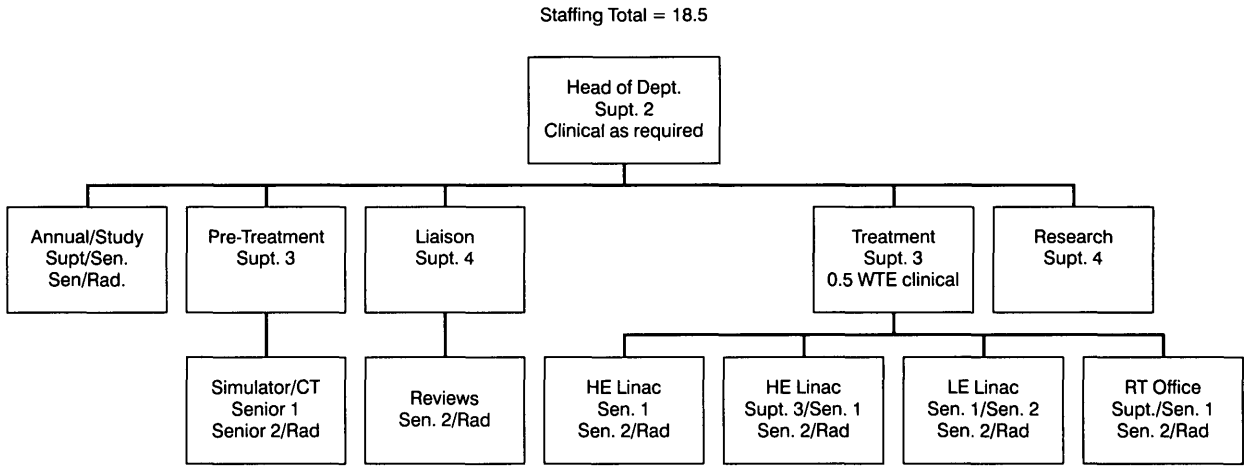

Figure 1

Address correspondence to: Stephanie McWilliam (DCRT), Plymouth Oncology Centre, Derriford Hospital, Plymouth PL6 8DH, UK

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STRATEGIC OBJECTIVES

Planning a service from scratch can be a daunting prospect so the whole process began with wide-ranging consultation about the collective strategic objectives of all the relevant staff groups (e.g. doctors, physicists, MTOs, administrative and radiographic staff). This made it much easier when life got complicated and some decisions were supporting one or two objectives but conflicting with others. Going back to the main, prioritised aims helped with the final decisions. The main objectives were eventually agreed as:

- Safety: a service which was as safe for patients and staff as possible, in all respects.[2]
- Accuracy: a service capable of providing radiotherapy as accurately as current technology permits.
- Reliability: a service where no patient needed to suffer the stresses of interruptions to their course of treatment.[3]
- Improved data management: a service where we had efficient access to data for audit, research and business planning purposes.
- CPD: a service supporting opportunities for staff development in order to continuously improve the service.
- A pleasant environment: both patients and staff benefit from working in pleasant surroundings.

There were other minor objectives but they tended to fit with the main ones and rarely conflicted with them.

TASKS AND PROCESSES

Keeping the objectives in mind, the next stage was to break down all the tasks and processes involved in service delivery and consider who currently did this task, who could and who should (Table 1). Initially, it felt uncomfortable to be looking at a health care service in the same way as a production line manager might in order to provide a more efficient service. However, an occasional look at this from the other perspective helped – would we want to be planning an inefficient service? Would we wish to use an inefficient service? Plainly, the answer is no and so the striving for greater efficiency continued!

These examples have been selected to demonstrate that, in some cases, the old way is still the best way. In other cases it has changed to a different staff group and in some ways it has changed from people to equipment but retains some flexibility.

PUTTING THEORY INTO PRACTICE

Staff

However good the equipment and design of the building, the service was only ever going to be as good as the staff using it and working in it. Plymouth was fortunate in having an ideal radiographic profile – a combination of very experienced people and younger, more forward thinking members of the team. This provided a good

Table 1. Examples of tasks and staff groups

Task	Old way	Possibles	New way
Request for RT	Oncologist	Oncologist	Oncologist
Making appointment	Supt. Radiographer	Supt. Radiographer, Receptionist, Secretary	Receptionist
Contacting patient	Supt. Radiographer	Supt. Radiographer, Receptionist	Usually Receptionist but may need to be Radiographer
Booking transport	Receptionist	Receptionist, Radiographer, RT helper	Receptionist
Transferring data from simulator to treatment sheet	Radiographers	Radiographers, networked computer system	Networked computer system
Collecting statistical data	Radiographers	Radiographers, admin. staff, computer system	Computer system

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balance between trying to go too far too fast and staying with old habits for no particularly good reason. There was also a spread of personal interests, giving strengths in different areas, such as pre-treatment issues, computers, patient care priorities and innovative techniques.

Well before the move, a team building exercise was held to focus on common aims and shared purposes. After discussion with the radiographers, this was held on a Saturday, away from the department and using an external facilitator. Most staff now feel this was a turning point in attitudes and motivation, so is felt to have been a worthwhile exercise. Apart from providing an opportunity to identify common aims, the ideas expressed contributed to the final agreement on strategic objectives.

The next phase was training in computers and the Windows® environment, in preparation for more integrated use of a networked system. One member of staff had already received additional training in computer skills and volunteered to set-up and deliver a training programme to all his colleagues. This proved to be extremely successful and even enjoyable. It was also important because it brought all staff up to a similar level of competence and confidence. In common with society as a whole, there tended to be a lower level of experience and confidence with computers amongst the older and more senior staff (although not exclusively) and it was important to address this early on.

Training on the new equipment was organised by a cascade method within teams. Previous staff who had left to have families were persuaded to return for a fixed term to support existing staff whilst colleagues were released for training on the new equipment. Two individuals were trained by applications specialists from the company for the simulator, two for the linacs and two for the network. The training for all other staff was divided into linacs (2 days), simulator (2 days) and the network system (2 days) for everyone, delivered by our own 'in-house' experts, who were the resource for trouble-shooting over the first few weeks after the move.

Annual staff appraisal had been in place for some years prior to the move and so some key people were obvious choices for some of the tasks but all staff had a role to play in maintaining the existing service and contributing to the new one. By this time, it had been decided that in the great 'specialisation versus flexibility' debate, it was preferable to go for greater specialisation. However, it was considered vital that the service should not be dependent on a single individual in any area so two dedicated staff were appointed for the simulator. The issue of patient care was more difficult and, in the end, was heavily dependent on one person, an issue which is hopefully being addressed now.

Equipment

As all the existing equipment was being written-off, evaluation of the different manufacturer's products was conducted according to agreed and weighted objectives, which followed from the strategic objectives of the service as a whole. Safety was obviously an important criterion but, in fact, all manufacturers are able to offer moving or dynamic wedges, multileaf collimators and other aids to a reduction in manual handling tasks. All comply with relevant legislation and all can provide accurate radiotherapy so there was little difference in these areas. As a result, the most important criterion by far was reliability.

Early discussions with sales staff had made it clear that Plymouth Oncology Centre was looking for innovative ideas on how manufacturers could and would back claims of guarantees on up-time and throughput. In the end, the need for private finance proved to be unexpectedly advantageous in this respect. The final contract was based on the principle that the service would need to treat 100% of booked patients every day at a normal rate of 6 per hour and, in 97% of cases, this should be achievable between the hours of 08.30 and 17.30. On some days, the service could be operated over a longer time but would still treat every booked patient and would have the ability to treat emergency cases at any time e.g. there would always be at least one linac working at all times. Substantial financial penalties have been agreed if the linacs are not available to meet these contractual requirements and the purpose of this is to ensure a swift response to any problems and consider how much maintenance is required and when this is done. It is a very different arrangement and took some time for everyone to understand. For example, it is no longer a decision for the department whether to

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mend or replace a worn part, when and whether to problem-solve intermittent faults and whether to service the equipment weekly or monthly. The staff notify the service engineers when there are problems and let them decide what action to take.

This is possible because of the decision to have an alternative linac for every patient and to have matched beams on all three. In the event of problems, the patients are moved onto another unit. As all three linacs have portal imaging units and multileaf collimators and all rooms have the same range of patient positioning devices, the patient list for linac A can be called up on linac B and all information and requirements are there for assisted set-up, verification, conformal treatments etc. If there are problems with electron beams on linac A, patients having photon treatments on B can be moved across and all electron treatments delivered on linac B. The only items which need to be moved are patient specifics, such as head shells and individual electron inserts etc. As all beams are matched, there is no need for replanning, changes to monitor units, recalculating etc. (There are a very few specific situations where some adjustments may be made for more than one treatment between the low energy and the high energy linacs.)

One essential component of the relocation was extremely rapid installation and commissioning of all the equipment. It had been agreed that all the linacs would be fully commissioned – all beams, all energies, asymmetric jaws, enhanced dynamic wedges, hard wedges, MLCs and portal imaging before they were handed over for clinical use. Whilst not all the information gathered is in full use (e.g. to date no hard wedge has been used clinically), all the measurements were collected between delivery on 15 September 1997 and first clinical use on 16 February 1998.

Another advantage was that upgrading was built into the contract. Instead of having to find substantial additional funds to keep up to date with new developments, it is either built in to the operating lease costs or can be added to the total package, with the costs spread over the lifetime of the equipment. For an organisation like the NHS, which can make neither a profit nor a loss each year, there are significant benefits in having a fixed price for the equipment including maintenance. It is well known what damage the failure of a major component can do to the budget!

Design and layout

Having a fairly clear idea about the way the service was intended to work helped in the design of the building. The simulator control area is large, partly because it incorporates the control area for the superficial unit which is low use. This permits the oncologist to be reviewing notes and films of the next patient whilst the radiographers are acquiring all the set-up data from the previous patient. Two workstations for the network also facilitate this.

Also, the siting of the examination rooms for treatment reviews opposite the simulator enables the oncologist to review patients between simulation if they so wish. The treatment planning suite is also opposite the simulator, as is the mould room and workshop, saving valuable staff time in passing information or dealing with queries across the whole of the pre-treatment process.

Probably the issue which has generated the greatest interest is that the linacs are staffed with only two radiographers. The reasoning behind this was that new technology was designed to make the treatment delivery process quicker and easier. It therefore requires fewer staff, not more and reduces the risk of errors when too many people are involved and 'everybody thinks somebody else has checked this or that'.

It was also felt important that the treatment radiographers could give their undivided attention to the patient receiving treatment. When the tasks undertaken on the linacs were reviewed, it became apparent that many of them not only could be done elsewhere but, in fact, were better performed away from the linacs. As noted by Bate et al, human error is a factor in incorrect treatment and automated data transfer can assist in overcoming these problems.[4] To achieve this, calculations, checks, data input (where needed), end of treatment summaries and technical and appointment queries were taken away from the linacs and undertaken in the radiotherapy office. There was a need for a good sized room to accommodate the workstations and desktop area for these functions near but apart from the linacs and this was built into the design process.

Probably the best decision was to redirect the telephone lines from the linacs to the office for the first few months. Although they are now back in

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use (for instance, for bleeping the porters) the habit of ringing staff on the linacs unnecessarily has been broken.

Using assisted set-up, record and verify system, MLCs and portal imaging, the patients are booked at ten minute intervals and only rarely is it necessary to give a double appointment. The complexity of modern techniques means that staff need to be able to concentrate on the set-up. R & V systems are no substitute for qualified, skilled and knowledgeable staff understanding what they are doing. No amount of checks beforehand can ensure safe delivery of treatment as well as a highly competent radiographer looking at the beam size, shape and direction, wedge orientation or beam shaping. There is also an issue around dilution of responsibility when more and more checks or people are added into the system. Ultimately, the patient's best chance of accurate delivery of treatment depends on the professional judgement of the radiographer considering the patient's position, comfort, compliance, achievability of the planned beams etc. and knowing clearly that this is their personal responsibility. It is for this reason that treatment delivery should be seen as a specialisation in it's own right and not as something that people do if they do not choose to specialise in anything else!

THE PATIENT'S PERSPECTIVE

So how does all this appear to the patient? What is the experience of radiotherapy like when this highly efficient service is in action?

On arrival at reception, they are greeted by the receptionist who may already have contacted them about their appointment and discussed their transport arrangements with them. By checking them in on the networked system, the receptionist ensures that the simulator or treatment staff know that this person has arrived as they now appear on their 'queue'. For the first few visits, radiographers will collect them from reception and show them to the changing cubicles (if necessary) and then where to wait, in the subwaits near the simulator or linacs. After the first few visits, patients are often happy to be called up to get ready via the intercom system.

In the simulator, the planning process is explained and simulation (or CT planning) proceeds. Unknown to them, all the relevant information is captured on the system and held on the file server. It can be called up on any workstation so doctors in clinic or in their offices can view data and images about that patient remotely, if required. Since the data is electronically transferred, the risk of transcription errors is negated. Once the planning or calculating and checking is completed, the patient is contacted again to come for verification and first treatment.

Again, patients are checked in at reception and, once called up, enter the room for treatment delivery. Once the radiographers have selected them from their list, their set-up details are on the in-room monitor, and the patient is positioned as required. On the first day, set-up is from the plan, in order to check the settings in the system but on subsequent visits, using assisted set-up allows the radiographers to give more attention to the patient, checking how they are and whether they have any problems. The two radiographers leave the room to deliver the first field and only one returns to use assisted set-up for subsequent fields, whilst the other remains outside, bringing up the next field. This is also in line with the recommendations of the Clinical Oncology Patients' Liaison Group 'The absolute minimum number of essential staff should be present in the room'.[5]

If the patient needs to see the liaison radiographer, a doctor or the dietician, for example, they are escorted to the exam rooms, where the liaison radiographer will already have met them during the 'start of treatment chat' which is booked at the same time as the verification appointment. If there is any action required, the liaison radiographer will alert the treatment staff by entering an activity note. This will appear on screen the next time the patient is called up and will not be removed until it has been signed off electronically.

Recent monitoring of patient's views show that patients are very happy with the service, believe they are treated as individuals and are treated promptly. (No patient waited more than 30 minutes and 83% were treated within 10 minutes of their appointment time. Since the relocation, no patient has had a course of treatment interrupted due to equipment problems.)

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THE RADIOGRAPHER'S PERSPECTIVE

What is it like to work in the Plymouth department? It is undoubtedly hard work and it is the staff who are paying the price for the improvements in the service. However, the work is fitted into a normal day and it is less common for staff to have to work more than seven hours. An hours lunch break is usually protected as the QA checks are performed during the radiographers lunch break. The lunch breaks/QA are staggered on the three linacs so that, if one machine is running behind, it can still be handed over for QA and the patients transferred to another linac.

Appointments are booked according to technique. Most of the head and neck cases are booked onto linac A in the afternoons. This means that once the headboard is on the couch, it can stay on for a run of patients, which reduces the amount of manual handling. It also means that the staff who are involved in research or development work on head and neck treatments can be based on linac A so that they are in the right place to support studies or new techniques (see CPD below). Since the oncologist specialising in head and neck cancers does her reviews in the afternoons, the patients appointments do not have to be changed for them to be available for review at the appropriate time. The head and neck support group (staffed by radiographers, MTOs, nurses, dietician, dental hygienist etc.) meets in the afternoon so that patients can have all their appointments co-ordinated for their convenience and do not need to wait or make a separate journey.

Similar arrangements are in place for patients having radiotherapy to the pelvis (linac B in the mornings) chest cases (linac A mornings) and breast cases (linac C – mornings and afternoons). Whilst patients are encouraged to accept the appointment times given, special arrangements are made for people with particular difficulties.

Although the delivery of treatment is intensive, staff rotate from one linac to another and also through the office, simulator and liaison, supporting the specialist radiographer or covering for leave. It must also be said that the radiographers in Plymouth would have had more concerns about concentrating other tasks elsewhere if there was not a high level of confidence in both the liaison radiographer and the facilities available in the support centre. Whilst it is a nice idea to be able to provide a comprehensive service for one's patients on a linac, this has always had limitations (for example, it has never been normal practice for the same staff who simulate to deliver treatment). If the priority is the best service for the patient and if this is provided by developing specialists in simulation, reviews and treatment delivery, it is at least worth considering.

CONTINUOUS PROFESSIONAL DEVELOPMENT

It might be a cause of concern that a service so geared to efficient working leaves no scope for continuous professional development. However, all the radiographers in Plymouth (with the exception of two people for personal reasons) are involved in at least one area of research or development. By keeping control of the appointment system, the treatment superintendent is able to organise the rotas to support this work. Currently there is spare capacity and this is protected to facilitate CPD. Nominally, linac B is booked for clinical work in the mornings only. However, because of the matched beams and networking, this can easily be linac A or C instead. Therefore, the staff on linac B are available to pursue developmental activities in the afternoons or to cover colleagues in other work areas where required.

The range of activities include research projects on patient positioning, skin care, acrylic versus thermoplastic shells, counselling, evaluation of virtual simulation, developing protocols for decision-making with electronic portal imaging, developing protocols for administration of medicines for the treatment of radiotherapy side-effects, quality assurance auditors, staff advocacy for bullying or harassment and various other activities. Where the decision is made to embark on a new research project (whether commercial or not), the research radiographer will take the lead in devising protocols, gaining ethics approval, determining appropriate tools for analysing the results etc. but will have a clinical radiographer to support the project. This person will have identified themselves either by suggesting the project or expressing a particular area of interest at appraisal.

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Staff training is well supported, both financially and in time. Study leave is booked in the same way as annual leave to ensure that the main service requirements are not compromised whilst developments continue. This is further supported by fixed term posts for specific projects funded from commercial research.

THE ENVIRONMENT

Throughout the planning of the new department, consideration was given to the working environment. This was enhanced by the involvement of 'Hospital Arts Manchester' who appointed a hospital arts co-ordinator to fund raise and commission art work and to give the whole building a theme. Using the geography of Plymouth as an analogy of the oncology journey (all at sea on diagnosis, needing to pass through the high-tech city centre – treatment; in order to reach the moors – life, future etc) the building has a coherence and added interest. Not all the art work appeals to everyone (quote: 'as soon as you move away from magnolia, you upset someone!') and some has caused considerable debate but user feedback has suggested that overall, it is a very pleasant area. There have been problems with floods, temperature control, draughts and space utilisation but there have also been many positive comments about the peaceful atmosphere. Several oncologists have commented that it never looks chaotic or busy, which is a mixed blessing and, as the workload increases inexorably, may actually work against us. If it doesn't look busy, do they think it isn't? Most amusing are the comments about how calm and orderly everything is – which is a testimony to the professionalism of the staff when you know that behind the scenes are radiographers performing Herculean tasks, resolving difficulties, making urgent phone calls, checking and rechecking, organising and reorganising before emerging serenely from the office to continue the illusion!

CONCLUSION

So, the patients are happy, the staff are happy and the finance director is happy. What is the catch? If we were starting again, undoubtedly we would do some things differently. . . but not many and not very differently. It is impossible for most departments to emulate this way of working (even if they wanted to) because most departments have a rolling replacement programme and are limited in the options for networking disparate machines and in the existing design of the building. It is impossible to separate out the three component parts (the right staff, suitable equipment and design) – they are too closely interconnected and integral to this way of working but undoubtedly, the new technology in the right hands can improve efficiency without compromising the quality of patient care.

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