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A contemporary case study illustrating the integration of health information technologies into the organisation and clinical practice of radiation oncology

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Abstract

The development of software in radiation oncology departments has seen the increase in capability from the Record and Verify software focused on patient safety to a fully-fledged Oncology Information System (OIS). This paper reports on the medical aspects of the implementation of a modern Oncology Information System (IMPAC MultiAccess, also known as the Siemens LANTIS) in a New Zealand hospital oncology department. The department was successful in translating paper procedures into electronic procedures, and the report focuses on the changes in approach to organisation and data use that occurred. The difficulties that were faced, which included procedural re-design, management of change, removal of paper, implementation cost, integration with the HIS, quality assurance and datasets, are highlighted along with the local solutions developed to overcome these problems.

Keywords

Radiation oncology, computerised medical record systems, database management systems, systems integration, professional practice, organisational efficiency

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This paper reports on the medical aspects of the implementation of a modern Oncology Information System (IMPAC MultiAccess®, also known as the Siemens LANTIS®) in a New Zealand hospital oncology department. The department was successful in translating paper procedures into electronic procedures, and the report focuses on the changes in approach to organisation and data use that occurred. The difficulties that were faced, which included procedural re-design, management of change, removal of paper, implementation cost, integration with the HIS, quality assurance and datasets, are highlighted along with the local solutions developed to overcome these problems.

Keywords: *Radiation oncology*; *computerised medical record systems; database management systems; systems integration; professional practice; organisational efficiency*

Modern radiation oncology departments use one of a number of sophisticated software suites that can be described as Oncology Information Systems (OIS). The OIS was originally developed from the Record and Verify software of the 1980s.

The Record and Verify software was developed to warn of human error in setting treatment fields on a radiation machine, and continues to do so. A relational database contains the intended settings for each field used on an individual patient, with hardware intercepts on the radiation machine delivering the actual settings for display and software comparison. Staff are notified of discrepancies which they can alter on the machine or override, before starting treatment. The parameters used when delivering the radiation were then written to the database and locked in. More recently, this functionality has been extended to use the intended parameter settings to set up the machine and step through treatment delivery much like the operation of a *.bat file.

The inclusion of treatment scheduling was a natural extension of the relational database because of the unusual requirements of the radiation oncology department. At the time, no other medical scheduling software was able to book two to 30 consecutive days of treatment, which is a unique requirement within medical practice.

In 1999, due to the Y2K issue, the radiation therapy department in a New Zealand hospital was required to upgrade to a Y2K-compatible Record and Verify system. An investigation of the functional abilities of the available software indicated that while all of the available OISs possessed the ability to manage demographics, documents, charges, resource management, disease parameter specification, chemotherapy drug delivery and scheduling, at the time the usability of the different offerings were substantially different.

The major selection criteria for the medical staff included the ability of the system to function as a clinical disease database, and the ability of the system to replace current paper procedures. At the time there were no departments outside of the United States, and only one inside, that had implemented any of the software choices to achieve either of the criteria above. After consideration of the options and the functional specification of an acceptable system (see Appendix), we elected to purchase the IMPAC MultiAccess® Oncology Information System, although this was marketed and sold by Siemens Medical Solutions as the LANTIS® Oncology Management System under a licensing agreement.

Radiation therapy aspects of this department's implementation have been described previously. This account examines the re-organisation from the clinician's viewpoint (Phillips et al. 2002).

Installation and implementation of the program

When purchasers of a new software system have little experience of the product and no access to 'mentor' sites, the understanding of the potential of a system can sometimes be rudimentary, based more on sales talk than on fact.

A number of events altered and matured the implementation direction undertaken by lead staff in this program. While the usual medical paradigm for data collection revolves around the data manager role, managers refused to undertake the additional expense of employing staff as data managers. As a result, a different medical paradigm was required, which was based on physician entry of data as part of routine clinical work. Paradoxically, this proved to be a major boon to the implementation strategy. Soon after installation of the OIS, lead medical and radiation ther-

apy staff were able to investigate the system more fully and to better judge its potential. It became clear within a few months that not only could the system be easily implemented as an electronic medical record, but that it had been designed as such. The lead staff, consisting of the Clinical Director (a radiation oncologist [AM]), the Chief Radiation Therapist and an interested and IT-capable Radiation Therapist (AP), therefore formed a project team to utilise the process design within the software to significantly alter routine departmental functioning.

The project team formulated six major goals for the project. These are discussed in the following sections.

Transition from a paper based clinical system to an electronic medical record

On discovering the capabilities of the software, we decided to produce an electronic medical record which contained all the information which was currently contained in clinic notes, with the additions required to comply with national legislative requirements.

We consciously resisted the urge to realise the full potential for infinite data collection during the initial implementation. Such capability is often met enthusiastically with a plethora of new items, resulting in greatly increased workloads and subsequent rapid diminution in enthusiasm for the entire process.

The particular product purchased included an option for an infinitely expansible table for clinical and non-clinical assessments. The project team were very careful to reproduce only those items which were currently collected to replace current practice.

Establishment of electronic data collection processes that exceed the accuracy of current manual processes

Several features of our implementation made achieving this aim easier than expected.

First, data required to undertake a clinical process (e.g., to decide whether radiation therapy is beneficial, an oncologist needs to know the patient's cancer diagnosis and stage) was assigned to the group that first met the data within a decision making process. This paradigm was called ‘data ownership’.

Second, the data owner was required to enter the data as soon as it became available, and any consequent decisions made were recorded immediately. This action also reduced the unnecessary duplication of data as the data repository was always up to date.

Third, progression of the patient through the system was dependent on the completion of this data. In accepting a patient for radiotherapy, bookings for planning or treatment could not be made until ‘downstream’ staff could see the decision data which needed to be entered in the appropriate place. Incomplete data forced a block to a patient's progress, and a notification to the clinician of the incomplete entry.

Fourth, the collected data was subject to routine quality assurance (QA), and the data owners were responsible for the QA. Routine reports interrogated the database to discover where mandatory data was blank or was inconsistent. This performance review was designed to be educational rather than punitive, so that routine performance could be improved. These reports were unable to ensure accuracy, only coverage and consistency with accepted rules (e.g., a T1 breast cancer will be 2.0 cm or smaller).

Improve and extend access to the collected electronic clinical information from all sites where staff worked

The department serviced a large peripheral community up to 420 km distant, making up more than 60% of patient workload. The project team identified the need to be able to carry all changes and improvements into the peripheral clinics as a major challenge.

On reflection, this was easily achieved with a close dialogue with IT staff, but required substantial involvement and planning within that department. With the external access being achieved through VPN use, oncologists had access to the clinical information in other clinics, at home and even overseas.

Reduction in workloads by reducing duplication in information collection and building in quality assurance

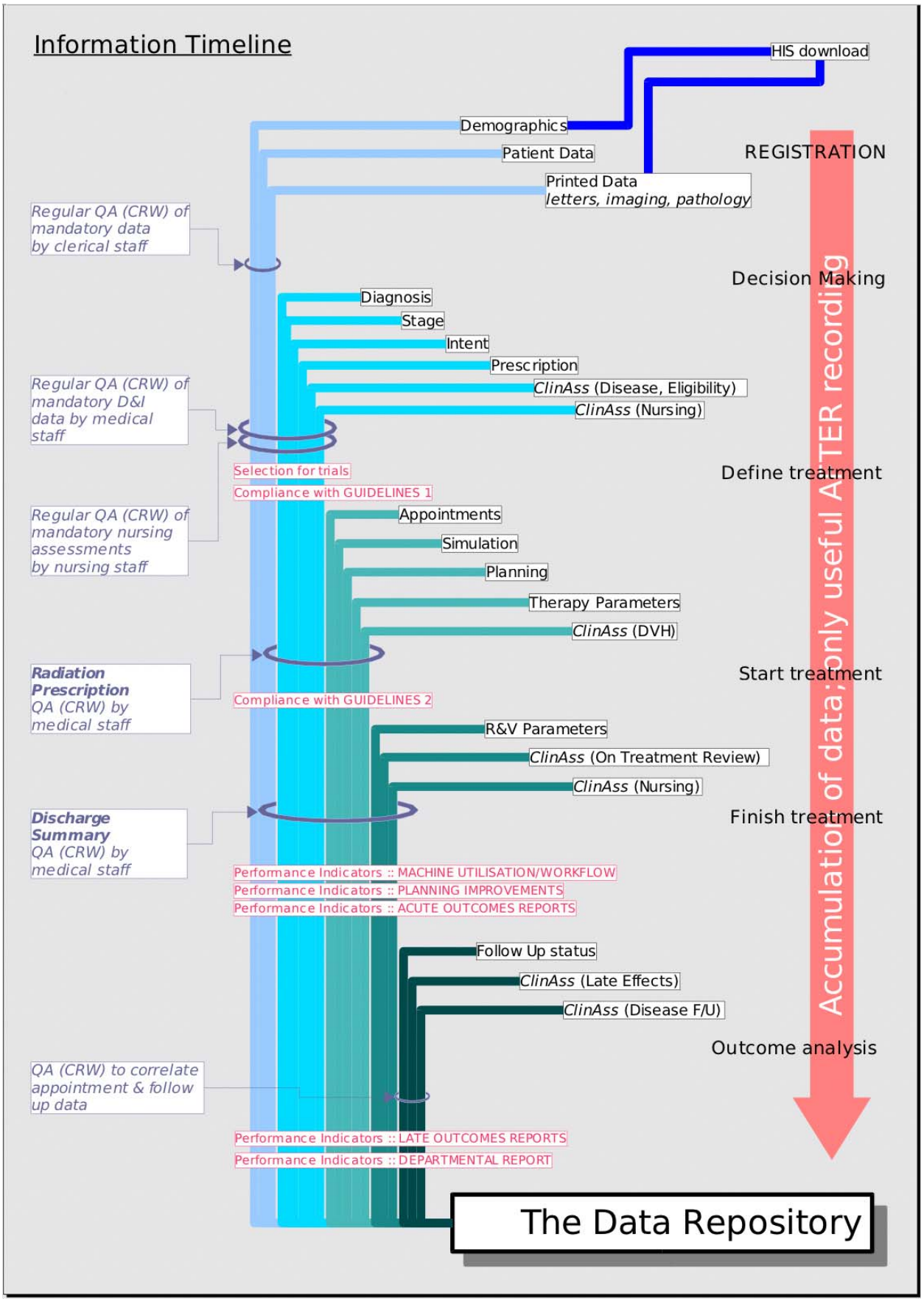
Within the paper procedures, medical staff found themselves providing the same data to multiple staff, even without considering the requirement to identify each sheet of paper with the patient's demographic data. The project team initially utilised the notion that the consolidation of processes into a single repository would reduce duplication. We did not appreciate until later the additional improvements that resulted from a change in the ordering of processes so that staff could always work with all the necessary information already available. This step included the linking of Hospital Information System (HIS) with the OIS to provide demographic data from the New Zealand National Patient Database.

A diagrammatic representation of this stepwise accumulation of data is shown in Box 1. The graphic clearly demonstrates that as data is accumulated it is available for use and analysis before the patient has completed treatment.

Ease the achievement of certification by aligning our processes with the requirements of the hospital and New Zealand accreditation bodies

The move from paper to electronic procedures permitted a redesign of systems to match the requirements of the modern era. To achieve this, the project team took the view at the start of the implementation that there were prerequisite and necessary processes that were already expressed in finite idiosyncratic paper procedures.

1: A graphical description of the planned cumulation of electronic data to demonstrate its clinical usefulness when accumulated at first revelation



Rather than translating procedures, we returned to the underlying processes and looking at the modern requirements, we rebuilt a new set of finite idiosyncratic electronic procedures. We felt no compulsion to make our electronic procedures mirror or resemble our past paper procedures, only to complete the same processes more safely and more easily.

Once processes were defined, staff were then assigned responsibility and the procedure set also designed. Processes were designed with an input and an output. By design the output of the first process became the input for the second process, and served as the mechanism to hand-off responsibility downstream. All processes included a task list in the Quality Check List section (QCL), which included entries pertaining to the process, as well as items for the next process. In this way, the formal output of the process (e.g., the clerical person responsible for registration made an electronic appointment) accompanied a second and independent hand-off (e.g., a QCL item to ask for the oncologist to complete their data from the consultation process). An individual could have responsibility for a number of processes.

Development of a database of sufficient quality to permit audit and reporting of both clinical and statistical information automatically

For the medical member of the project team, the major concerns were to reduce workload in the short term through elimination of repetition, and in the long term to have a prospective, accurate, reportable database of clinical information from which treatment outcome and improvement could be demonstrated easily and repeatedly.

Indeed the project team subsequently discovered that a plethora of statistical information was also easily available. The quality assurance for coverage and consistency meant that the data could be used to accurately determine answers for issues of resourcing, performance and quality.

In order to undertake implementation of a new procedure, project teams should investigate their current procedures that define necessary processes, looking particularly for individual requirements. The most useful points to identify include those which require quality assurance, and those interfaces which involve hand off to other professionals or parts of the system.

The process of defining processes and procedures should be undertaken in view of a detailed knowledge of OIS and knowledge of its inherent process engineering with defined and useful functions. The purpose of defining current processes is to ensure that the implementation into new electronic procedures is comprehensive, rather than to use the audit as a template to make the OIS fit the current paper based organisation. An illustration of our early process redesign is shown in Box 2.

Changes in administrative processes

The paper registration process involved pre-2000 is described below:

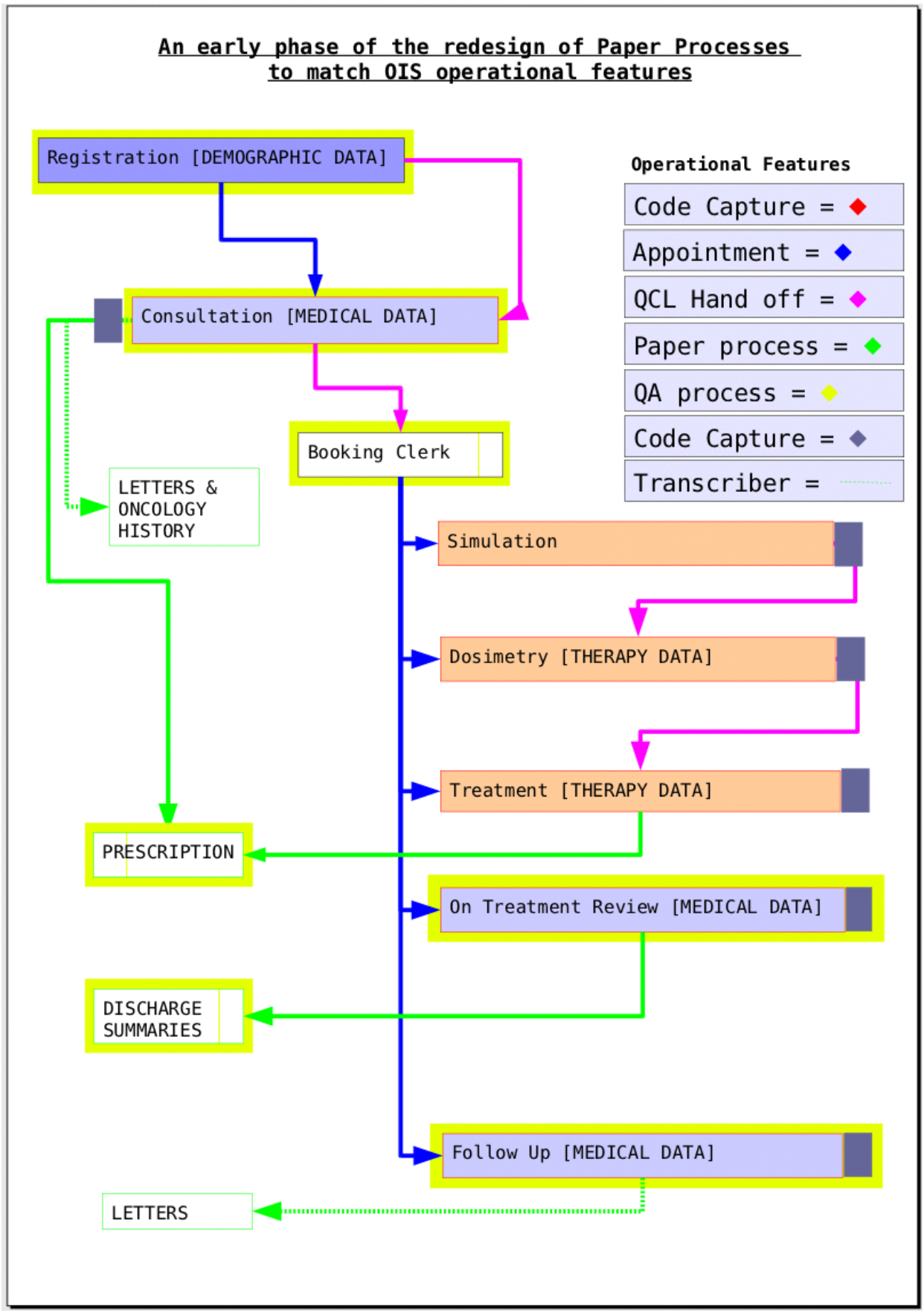
- Upon receipt of a referral letter, the patient's demographic data was manually transferred from the HIS into a stand-alone database.
- The disease type was entered in the stand-alone database. This field was a text field unrelated to any internationally accepted coding classification. As a result, a patient with lung cancer might appear in the database as ‘non-small cell lung cancer’, ‘NSCLC’, ‘lung cancer’, ‘right lung cancer’, ‘cancer R lung’, ‘NSCLC R, ‘right lung’, ‘Stage IIIA lung’, ‘3A lung’, and so on, through the entire permutation of terms. It was therefore impossible to identify reliably those with lung cancer. The database included no fields for staging, therapy, or outcomes.
- A cardboard file was printed from the database information.
- Names of consultants and general practitioners involved were written on a form.
- A front page which was designed as a summary sheet detailing the major diagnoses and treatments was inserted. This was not standardised, rarely filled out and never quality assured.
- The referral letter, imaging, biochemistry and histopathology reports were filed in appropriately marked sections.
- The patient's appointment along with contact details were entered into a large appointment book in pencil (to facilitate changes and alterations) and into the HIS appointments repository.
- The new file was filed in a large storage area. The day before clinic attendance, clerical staff collated the required files from storage. Dead patients had their date of death written on the cover and were culled from the storage area once a year.

The project team redesigned this system to utilise the electronic functionality available. The redesign of the process of registration is shown in diagrammatic form in Box 3, and was fashioned using a black box concept where the inputs and outputs are visible and act as hand-offs to other professionals and processes. The 'hidden' interior of the box forms the component that needs to be undertaken and ‘QA'ed’ by the group involved.

This early design demonstrates that there are 'quick hits' that can be achieved to improve workload very quickly, while other improvements are dependent on other staff (coordination with nursing over workload division, IT staff linking the HIS and OIS) and other software options (entering typed and scanned notes into the document manager option of the OIS called 'Transcriber').

In examining the altered systems, the reader should consider whether the resultant procedures are likely to be more work, and more likely to miss vital information. Using the same categories as above, the final process after 2003 is defined as follows.

2: An early phase of redesign of deparmental processes demonstrating where paper processes persist and where processes are connected electronically



Step 1

Upon receipt of a referral letter, clerical staff indicate in the HIS that the patient is now a patient of an oncologist. This triggers the download of the HIS demographic dataset to the OIS. Within the HIS a flag was set so that any change in the National Patient Dataset would occasion another demographic download. The National Patient Dataset also included a Date of Death when downloaded from the New Zealand Department of Births, Deaths and Marriages who routinely feed their death data to the National Patient Dataset. Hence Date of Death notification was automatic. As a corollary of this process, clerical staff are required to make changes to demographic data in the HIS, not the OIS.

Step 2

The clerical staff open the patient record in the OIS and select the names of involved consultants and general practitioners from the drop-down lists of doctors within the software.

Step 3

The process called for the referral letter, imaging, biochemistry and histopathology reports to be scanned and saved as images or document files, labelled appropriately (e.g., 'Histopathology report'). Numerical laboratory data, such as haemoglobin level or PSA level, can be manually entered or automatically downloaded via an HL7 gateway. Other third party products also permit the transfer of text reports (imaging and histopathology reports) directly into the notes section with the appropriate designation. Within the New Zealand setting, the majority of general practitioners were already operating electronic records and receiving HL7 feeds from laboratories. The project team realised quite early that our group were very poor users of the immense sea of electronic data already available.

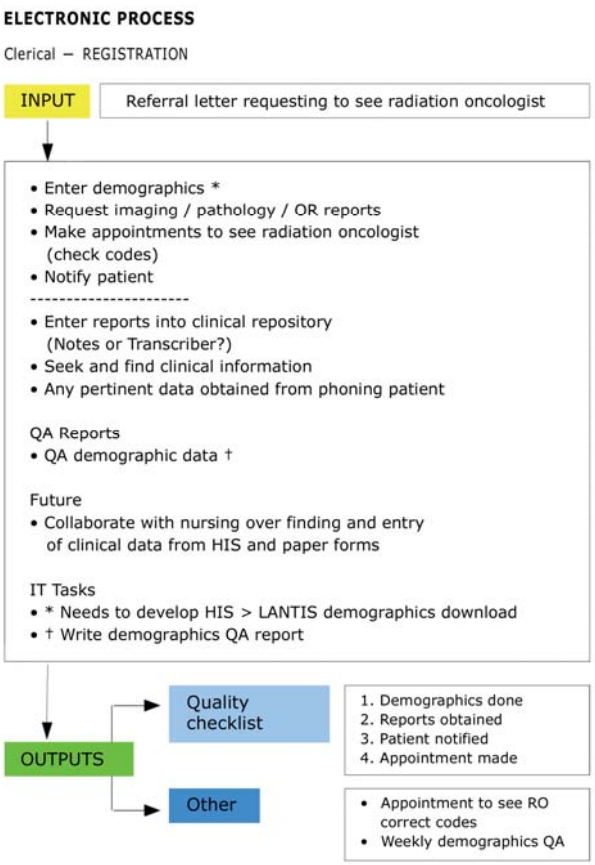
Step 4

When the patient is selected, an electronic appointment is made, and the patient is notified. The OIS permits clinics to be designated as 'New Patients' and for the system to default the appointment to the next available new patient appointment. No individual timetables were printed. The clerical staff printed one master list each day in case of system failure.

Step 5

The clerical staff could enter a disease category within the demographic data but this is not necessary at this point, as the oncologist enters the definitive disease diagnosis and stage according to ICD-0 coding immediately after consulting with the patient. The mandatory clerical entries in the demographic information are updated as part of the routine QA process for demographic data. Every Monday clerical staff compile an electronic report that highlights entries where mandatory data is missing or inadequate. The initial

3: Procedural specification of the process or registration, including the clerical process and responsibilities, relevant quality assurance and data issues within the OIS



database had two independent fields for diagnosis, although upgraded versions saw these consolidated into a single field. Moving to a paperless record in an integrated department would require all staff, including medical oncologists, to make the same transition. Unfortunately, as the lead discipline, the radiotherapy department needed to maintain a paper file although that department did not use the file. The new file cover was printed from the OIS using the automatically downloaded HIS data. Once the medical oncologists migrate to the same system, the paper records will cease to be accumulated.

Step 6

Once the clerical staff had completed their work, the file was not required for the consultation as all the information within the file was also contained within the OIS. Oncologists learnt to open a patient's file from the appointment schedule, particularly as clerical staff were no longer providing a paper record for radiation oncologists. The software contained the option to automatically display the photograph of any selected patient aiding identification. Changes to procedures were trialed by the lead oncologist and only introduced when subsequent changes had already been devised and tested. In this way the introduced changes were

stable. The lead oncologist undertook to train his colleagues.

Changes in clinical processes

The clinical consultation process pre-2000 consisted of the following processes:

Patient consultation

Consultation with the patient was undertaken using data in paper format and note taking on paper. A letter and history was dictated, printed and filed.

Treatment strategy

When accepted for treatment, a paper booking sheet was completed; this included demographic data, diagnosis, stage, intent of treatment, description of the intended prescription, the National Waiting Time category and whether accommodation was required. The sheet needed to be delivered to the booking clerk, which could take some time from peripheral clinics.

Planning

At planning, a paper prescription was provided that included demographic data, diagnosis, stage, the details of the prescription, and the oncologist's signature. Finalised treatment plans were printed and signed.

Treatment review

At treatment review, a clinical note detailing the patient's acute symptomatology was dictated, printed and filed.

Completion of treatment

At the end of treatment, the oncologist dictated a discharge summary consisting of demographic data, diagnosis, stage, intent of treatment, signed prescription, side effects during treatment and intended follow up. This was typed, printed and signed. The discharge summary was rarely sent within seven days of treatment completion.

Follow up procedure

At follow up visits, a letter was dictated, typed and filed.

This redesign began with the prescription step, where a large amount of writing was replaced with a single signature on a prescription printed from the OIS, that is, using the electronic data entered immediately after the consultation. This 'quick hit' defined a critical point. Previous steps to this became the sole responsibility of the oncologist while subsequent steps were the responsibility of the radiation therapist. This step required no additional software or involvement by other staff. The redesign of medical processes proved to be the defining step in the project as other staff took to new electronic processes with relative ease.

Using the same categories as above, the final process after 2003 is defined below.

Patient consultation

Consultation with patient with data in electronic format and note taking in electronic notes. A letter and history is dictated, typed and saved in electronic format. Although voice recognition software was trialed and proved useful, its incorporation proved to be a bridge too far.

Treatment strategy

After formulating a treatment strategy, the diagnosis, stage, intent of treatment, the preliminary prescription, and National Waiting Time category are entered in the appropriate places. The oncologist is also able to add previous oncological activities (such as surgery types). The patient is passed to the next process by raising a preconfigured list of quality check list items (QCL), including one for the booking clerk to request an appointment for planning, and another to notify the booking clerk of the need for accommodation.

Planning

At planning, the completed plan is reviewed on the treatment planning system and electronically approved if satisfactory. Immediately following this the preliminary electronic prescription in the OIS is reviewed and approved. The radiation machine will not work until this approval is provided and only the oncologists have approval rights within the OIS for this component. The demographic data, diagnosis, stage, and treatment intent can be reviewed but need not be added.

Treatment review

At treatment review, the patient's acute symptomatology is graded according to the categories within the clinical assessment option and the quantised data is entered directly by the oncologist.

Completion of treatment

At the end of treatment, the patient is reviewed by the nursing staff and a predefined set of clinical assessments (‘Nursing Discharge’) entered. The nurses print their Nursing Discharge Summary, which includes their assessments and any notes written by nurses, and also raise a QCL item for secretarial staff to inform them that the electronic discharge summary is ready for production. The secretarial staff open a report file, enter the patient's identifier and have a complete discharge summary in less than 30 seconds. They print the required copies and place them out for signature. The use of email and fax for transmission was planned as a future enhancement. The discharge summary contains demographic data, diagnosis, stage, intent of treatment, prescription, side effects during treatment, intended follow up and any medical notes entered during therapy. The electronic discharge summary is usually sent on the same day or day after treatment completion.

Follow up procedure

At follow up visits, a letter was dictated, typed and saved in electronic format. In addition, an entry is made in the follow up section, and any late side effects are entered in the designated section within clinical assessments.

Challenges

Choice

Current paper based systems do not function democratically. There is no choice whether a booking form is used. Departments require processes and they must be completed, be safe and be comprehensive for patient care to occur. In this matter the only issue of choice and negotiation is the format of procedures.

The move to electronic records therefore relies on one solitary choice – should the format of our system be paper or electronic? The answer is not unlike a Westminster-style election which then commits a department to some version of totalitarian government until the question is put again.

The importance of this cannot be overstressed as staff may approach subsequent changes from the viewpoint that each change will be voted on democratically. This tendency was clearly seen in our department and became more problematic as the duration of change lengthened.

The project team should consider adopting two approaches of engaging resources to develop a marketing strategy for selling the inevitable, and clearly defining the end product. The team should also recognise that the time taken for implementation can be too short, as well as too long.

Overcoming resistance to change can be difficult but should be a prime consideration of any project team. The team should provide a clear definition of the expected duration of change. Rapid change implementation requires a strong sense of the completed system and the ordering of required steps. Slow change implementation inevitably encounters the expectation that continued change requires as much consultation as the initial process. The appearance of the completed system should be detailed before asking for staff cooperation. A statement of departmental intent, with all staff members signing a charter, is a useful tool for including staff.

Resistance to change

While some people are invigorated by change, most have an aversion to any change which they themselves have not sought. Change agents who seek continuous improvement through constant refining are uncommon. The project team is more likely to be composed of change agents.

Since change is unsettling, the project team should plan to introduce changes two to three steps behind where their development efforts are concentrated. In this way, changes are likely to be undertaken once. Such a process presupposes that trail blazers are working on the changes. The benefit of changes should be demonstrated, and sufficient training resources should be available to support staff in the period of initial introduction.

Human resource consultants might be helpful for the consideration of team issues, although their usefulness will be limited by their lack of understanding of the details of either the paper or electronic system.

Managing the ‘death of paper’

During implementation we found it necessary to run parallel systems for short periods of around six weeks. During these periods, the primary systems were clearly nominated. Initially the electronic system was trialed against the paper system to train staff and quantify gains in efficiency. Subsequently, the electronic system was instituted and the paper system used as a QA mechanism to make sure that errors were not occurring. Once a reasonable period had elapsed without incident, the need for paper was then dropped and the lead oncologist removed all forms relating to the implemented step were removed from offices and clinics.

Management of dissenters

Some staff felt that they were expected to introduce changes that would eventually cost them their jobs, and were understandably resistant to change. Although it is quite easy to demonstrate that the role played by each staff member will change, it is more difficult to convincingly show that staff numbers would not be reduced. Project teams should identify strategies for the identification and management of staff who are not coping with change, including looking for other employment opportunities within the same organisation where electronic implementation is less threatening.

The project team identified the fate of stored paper files as a major undertaking. In New Zealand, regulations require files to be kept for 10 years after death and 40 years while patients are living. This department holds more than 15 000 files. The desire to consolidate these paper files into a sole repository stems from the desire of medical staff to utilise the long held data in the same way as the prospectively collected data can be used. Using this project, the project team estimated that surplus staffing would be employed for several years and that natural staff attrition would see a reduction in numbers, if efficiency gains could sustain the reduction.

Quality assurance

The project team were not saddled with a traditional quality assurance (QA) methodology. Data managers were not employed. The team wished to record a few items very well, opting not to cast a wide net over

possible data. The use of customised reports written in Crystal Reports enables the electronically entered data to be routinely examined for coverage of mandatory items and to introduce some logic testing to ensure that entry is consistent with published coding conventions. The reports were designed to instruct staff as well as highlight the corrections required, so that in the future staff would enter accurate data at first attempt. The reports were provided to staff as soon as practicable to ensure that accurate data is used downstream in the system.

Minimum datasets

The desire for more and better information is present in most organisations and is frequently reflected in the production of minimum datasets. The team obtained the draft New South Wales Department of Health Minimum Dataset for Radiation Oncology and compared the data that we were routinely collecting. Our routine collection achieved almost all requirements except for idiosyncratic requirements such as the identity of the laboratory producing the histopathological confirmation of cancer.

Integration and additional costs

Although not overtly stated, funding realities push staff to be fully cognisant of their future needs early in the tendering and selection process. Our project team found it quite easy to procure the cost of the initial system because of the Y2K imperative.

However we did not purchase the 'Transcriber' option initially as the software did not seem to work. Later during the implementation, when the team were better informed about the role and need for the transcription software and it had been seen to be working, the business case for its purchase was not actioned for two years despite the additional cost being only 5% of the original.

Management seem able to cope with the wastage of large sums of money on selecting multiple options that may never be used, rather than the wise application of limited funds on the slow expansion of the system to include only those options required.

Integration is the most difficult area of the project to predict, due to the large number of links that have had to be forged with other departments including information systems for networking and VPN services, laboratory services for HL7 downloads, and consultants for training in Crystal Reports. Additional costs in the form of additional user licenses were a continual problem as higher level implementations invariably involve more users.

Integration with hospital information requirements

Although the issue was not raised within our project team, other sites have reported to us that their plans for implementation of their OIS are threatened by information system departments who issue mandates that the HIS must be implemented within the oncology department.

The first unavoidable deficiency of this approach is that no HIS includes a Record and Verify system to run a linear accelerator, thus making the purchase of a specialist product necessary. Since all of these specialist products have an OIS attached which is specifically designed to manage the radiotherapy setting, the inevitable and eventual question is whether the use of an efficient, idiosyncratic, tailored system (OIS) locally with data integration to the remote HIS is better or worse than the use of a specialised product that is separate along with a non-tailored clinical solution and a central repository?

How much does all this cost?

The cost of implementation is extremely high but rarely recognised in the oncology setting. The costs in our circumstance were born by staff members doing extra unpaid overtime. If staff had been paid, the cost of implementation would have more than doubled the cost of the software purchase.

Summary

The radiotherapy department made significant progress in the implementation of an oncology information system through the intelligent melding of software capabilities with process requirements to produce a tailored system that has replaced paper to meet all of the prime requirements of the project. The change required a heavy input of time from the project team over a long period. This workload cannot be accomplished within a normal workload, and indeed much of the work was undertaken after hours. Any site committing to such a project should employ project officers, reduce the clinical workload of lead oncologists or seek consultancy services to manage the change.

Reference

Phillips A.K., Anson J., Sloman B. and Miller A.A. (2002). Integration of Radiation Therapy Information Systems. *Electromedica* 70(2): 111-117.

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Appendix: Functional specifications for a modern oncology information system (OIS) in a radiation oncology department

The OIS:

- Interfaces with:
  - the hospital information system for demographic downloads
  - HL7
  - DICOM RT compatible planning systems
  - other databases
  - (The above four requirements need only be achieved through the use of third part products or natively from the OIS. In this regard, a standards-compliant database and operating system is highly regarded.)
- Interfaces with all linear accelerators available in New Zealand and Australia
- enables functioning within a single coherent clinical workspace for oncologists, nurses and radiation therapists
- demonstrates a manageable, coherent, cohesive entry system for medical, therapy and nursing staff
- acts as an electronic repository for documents and images, with the ability to:
  - file and retrieve scanned reports in popular formats which will be able to be translated into future formats
  - identify reports relating to pathology and imaging reports, letters sent and received
- acts as a cancer registry with the ability to enter malignant and benign diagnoses and staging data, using internationally accepted coding (ICD-10 classifications for site and histology, TNM for staging)
- acts as a computerised clinical database:
  - able to specify, enter and retrieve as many prognostic factors as required
  - able to specify, enter and retrieve as many biological factors as required
  - able to specify, enter and retrieve any specific oncological activities (surgical and others)
  - able to enter and retrieve outcome issues relating to:
    - death
    - local failure
    - regional failure
    - distant failure
    - late side effects of treatment using internationally accepted classifications
    - treatment outcome (symptom relief, size change, etc)
- ability to enter a radiation prescription, which should be:
  - completed within the identified medical entry process
  - approved by oncologists alone
  - capable of preventing machine use until approval
- ability to describe a chemotherapy prescription with date, type, dosing, dose reduction. The option of a complete chemotherapy delivery system (i.e., a chemotherapy Record and Verify) involving drug prescription, preparation and ordering, as well as chemotherapy nurse and pharmacy sign off is beyond the scope of this document. Integrated departments wishing to use a single OIS should pay particular attention to the separation and integration of various features.
- ability to store or retrieve imaging and treatment volume data from the radiotherapy planning system. This can be achieved by treating this data as a prognostic factor or by direct download as part of DICOM RT plan transfer.
- ability to store, retrieve and assess radiation portal imaging
- ability to routinely retrieve data from the schedule, charge, demographics and treatment facets of the database
- demonstrated ability to report on stored data for clinically relevant uses including discharge summaries, outcome analysis, quality assurance, resource usage and process analysis
- ability to manage waiting lists
- possesses an electronic scheduler that:
  - permits the decentralised generation of appointments
  - permits generation of reports to quantify loss of efficiency and resource utilisation
  - is able to manage all clinic sites whether local or remote peripheral clinics
  - is able to generate multiple daily appointments, and regular followup appointments
- possesses a format to record clinical assessments that relate to:
  - treatment side effects (early and late)
  - treatment specification (any selection of DVH parameters)
  - any selection and number of additional facets (assume at least 1000 additional individual assessments covering areas such as EPI displacement, Machine QA, clinical trials which may or may not be utilised and cannot be specified beforehand)
- implements a management process for workflow which shows daily worklists for staff and possesses an audit trail of workflow
- possesses a dictation/transcription system:
  - that shows daily worklist for all staff involved
  - has the ability to quality assurance the dictation, transcription, proofreading and printing processes of letter/report production
- provides an implementation team consisting of at least an application specialist and an on-site implementation team (comprising high level radiation therapist and radiation oncologist users. Assistance in implementation in clinical departments is difficult to find, as medical staff with the requisite clinical acumen and credibility are invariably involved in clinical work rather than medium term implementation consultancy.
- supports multi-site installations:
  - across LANs
  - across ISPs
- provides secure access from off-site to the clinical record