



Original Research Article

Redesigning Radiology Reporting

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ABSTRACT

Background: The Radiology Pathway at the Royal Adelaide Hospital was established in late 2004 to improve access to imaging services that had been identified as a key bottleneck to the acute patient journey. This paper describes the improvement journey and outcomes achieved through the redesign of the radiology reporting process.

Method: Using a service improvement methodology focusing on staff empowerment for change, a multidisciplinary team was established to improve the imaging reporting processes.

Results: Despite a 2% growth in activity for the Radiology Service overall there was an increase from 70% to over 90% in the number of reports available within 7 days for outpatients. The percentage of inpatients with a report available within 24 hours has increased from 35% to over 80% and for emergency patients from 20% to 60%.

Conclusion: The Radiology Pathway model demonstrated that the application of redesign methodologies can significantly improve service delivery in relation to the provision of timely image reports. In addition the model has been applied to improve radiology support of the emergency department.

Key Words: Radiology, Imaging, Reporting, Redesign

INTRODUCTION

The current health mantra of increasing demand for services, financial constraints and staff shortages has led acute care hospitals to embark on significant service improvement, clinical redesign and change programs. At the Royal Adelaide Hospital, Patient Pathways was established with a goal to increase capacity and improve the patient experience. A beginning step in this program was to identify the significant bottlenecks in the patient journey, to target improvement opportunities. One of a number of areas reported as a key delay to

patient flow was access to radiology. ^[1] In late 2004 an improvement journey for the Department of Radiology was commenced and the outcomes achieved through the redesign of the radiology reporting process are described in this paper.

Background

Clinical redesign of acute care systems is increasingly being reported in the literature. ^[2,3] For the most part these clinical redesign programs have focused on Emergency Department (ED) processes, ^[4] discharge practices, elective surgery and bed management. ^[5] The majority emphasising

the importance of the coordination between departments and services [6] is a key requirement to optimise patient flow.

Coordination between radiology and clinical services is important to ensure timely diagnostic information to support clinical decision making. The radiology report of the patient image is a key clinical element of the patient healthcare record and assists in healthcare decisions. [7] But it is interesting to note in the redesign literature there is limited information about redesign programs focused on radiology services.

In the United States, a program was established to coordinate and align hospital resources that included a focus on the radiology department's outpatient services. [8] Work to create a radiology report process information data model that identified roles, tasks and information flows to underpin a redesign of radiology workflows has also been reported. [7] There does not appear to be any evidence of broader applicability of these specific pieces.

There are many pockets of excellence in radiology services with seamless information systems and the latest in imaging and imaging support technology. Many organisations now have well integrated radiology information systems, picture archiving and communication systems (PACS), electronic requesting and voice recognition. Whilst this provides the means to improve work flow this is not always realized. [9] In addition there are still many radiology services that function with old technology and information systems that are either not available or not fully integrated.

This paper provides a description of how the application of clinical process redesign can assist radiology services to optimise services within existing systems using radiology reporting as an example.

MATERIALS AND METHODS

A locally tailored hospital wide Service Improvement Model provided the methodology for the Radiology Pathway (Diagram 1). This model is based on Clinical Practice Improvement, [10] the United Kingdom National Health Service Improvement models [11,12] and the work of Deming. [13] A multidisciplinary workgroup was established in November 2004 to guide and develop the Radiology Pathway. This included representatives of the key staff groups within radiology (administration, radiographers, nursing, medical), inpatient clinicians and a consumer. The group was chaired by the General Manager of the Hospital.

The workgroup led a diagnostic phase that involved the establishment of a set of key clinical indicators (see table 1) and a monthly scorecard. In addition, extensive process mapping of patient flow through the department was undertaken. It did take the Workgroup a number of months to determine the indicators, appropriate measures and establish the scorecard using these indicators.

Table 1: - Radiology Clinical Indicators.

Indicators	
1a	Total Number of Examinations
1b	Total number of Reports
2	Request received to Image acquired by modality (Median minutes & % completed within 24 hours)
3	Image examined off to Report available by modality (Median minutes & % completed within 24 hours)
4	Patient waiting time in the Barouche Bay (Median minutes and % within 30 minutes)
5	Patient waiting time for OPD images (Average minutes and % within 30 minutes)

The process mapping of the patient journeys through the service was a useful mechanism to engage all stakeholders in the redesign process and identify the priorities for improvement. Sessions were attended by representatives of all staff groups working in each service area, usually based on the imaging modality. The process mapping for

each modality lasted approximately three sessions. The first two sessions involved documenting current processes and the third session determined a consensus view on the final map.

The overall mapping enabled a clear understanding of the imaging service as whole. This understanding included the different modalities, the different patient groups (inpatient, outpatient and emergency patients), the different services (imaging, interventions and reporting) and issues and

opportunities. To support this process a staff survey was undertaken to identify their ideas for service improvements.

Having obtained a better understanding of the radiology service two priorities for improvement was identified. One was the access and provision of imaging, including patient waiting, and the other, the basis of this paper, was the provision of radiology reports. Service improvement teams were established for each stream.

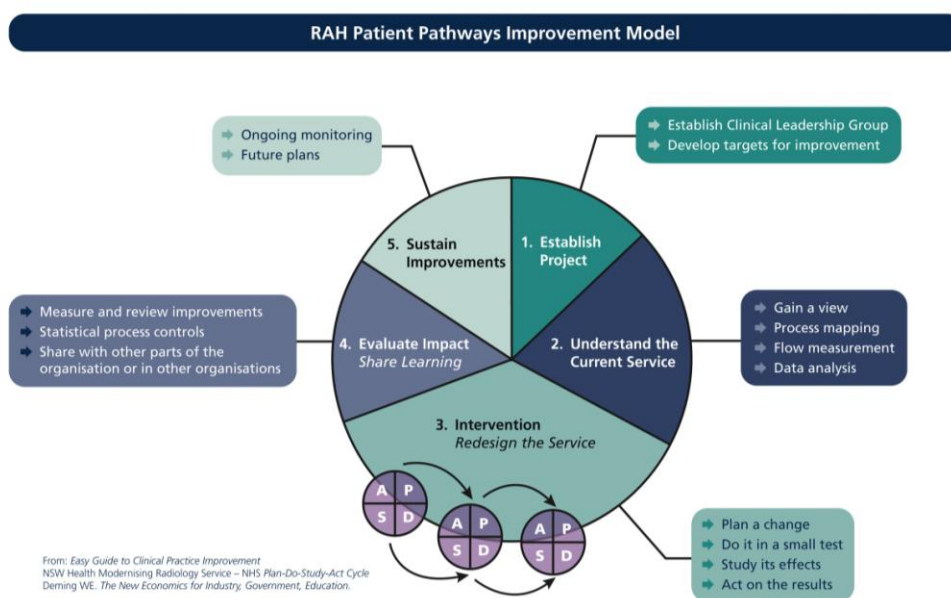


Diagram 1: RAH Patient pathway improvement model.

The Reporting Service Improvement Team (SIT) was multidisciplinary with representatives from the emergency department and inpatient clinicians. The goal of the Reporting SIT was to decrease the time before a radiology report was accessible to the clinicians. The indicator was the length of time from image acquisition (usually recorded at the completion of an examination) to the report being available to clinicians. This was described as average time and as the percentage of reported images available

within 24 hours for inpatients, 1 hour for the emergency department and outpatients within 7 days. The goal was 100% for inpatient reports within 24 hours and for outpatients within 7 days. A target of 75% of images reported within 4 hours for emergency department patients was determined to take into account the number of images that were not reported overnight.

The team identified a number of key improvements that would support achievement of the target including:

- Issuing of timely reported imaging information
- Digitising the reporting process
- Re-streaming the flow of reporting work

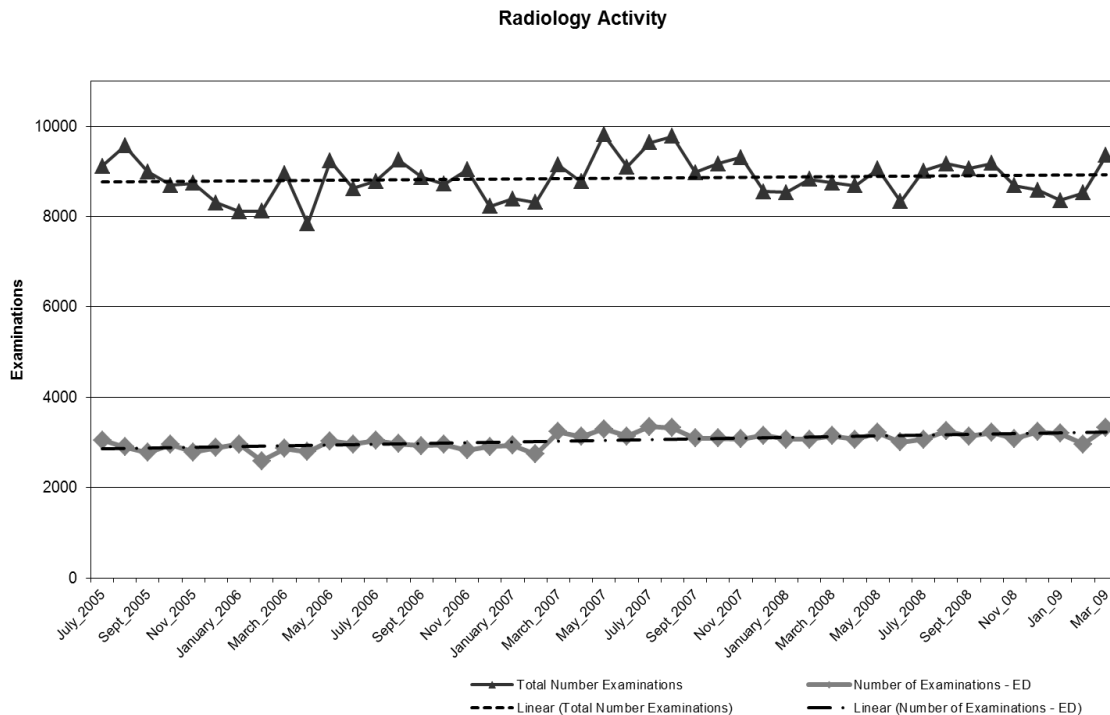
Data availability to support the Reporting SIT was available from the Radiology Information System (RIS). Demographics were provided by the Hospital Information System (HIS) to the RIS (Kestral RMS) which inter alia provided a unique identifier for each episode and time/date stamped each step in the episode. Reports were delivered to the Hospital clinicians' desktops via OACIS (Telus Health Solutions) which also time/date stamped the data. The data to measure the time and date of report progress was downloaded consistently. The data was then managed in a database (MS Access) and presented to the Reporting SIT. The data was used comparatively to show trends and as an absolute measure of performance. There was anecdotal evidence from

radiology staff and hospital clinicians that indicated there was an improvement in the delivery of reports.

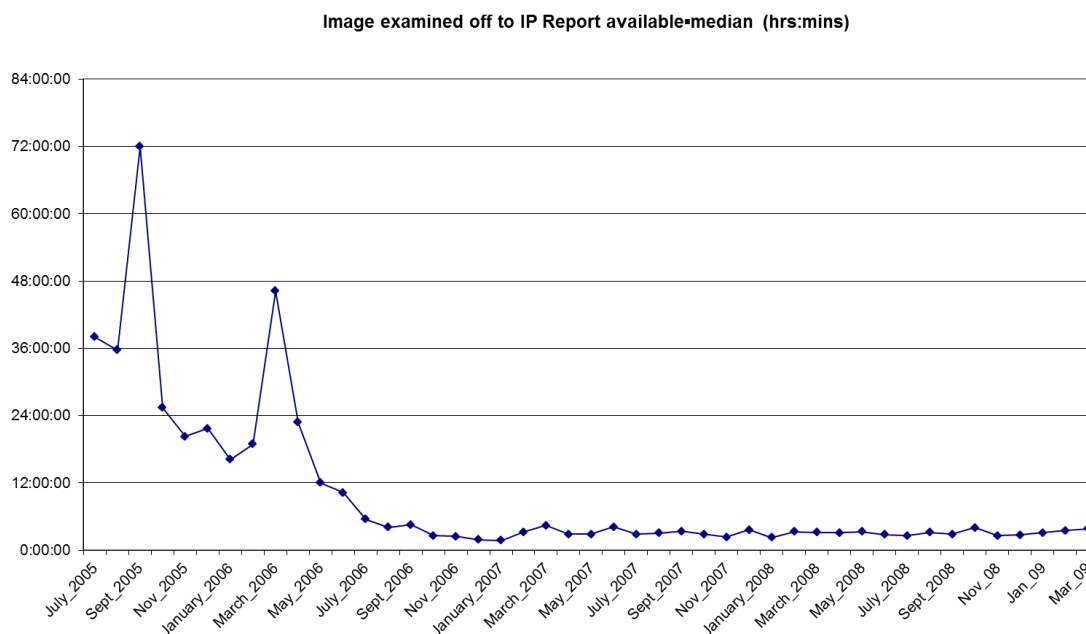
RESULTS

A number of initiatives have been implemented to improve overall reporting times. Broadly these relate to the issuing of interim reports, digitising the reporting process, and re-streaming the flow of reports based on patient status rather the traditional process of reporting by modality.

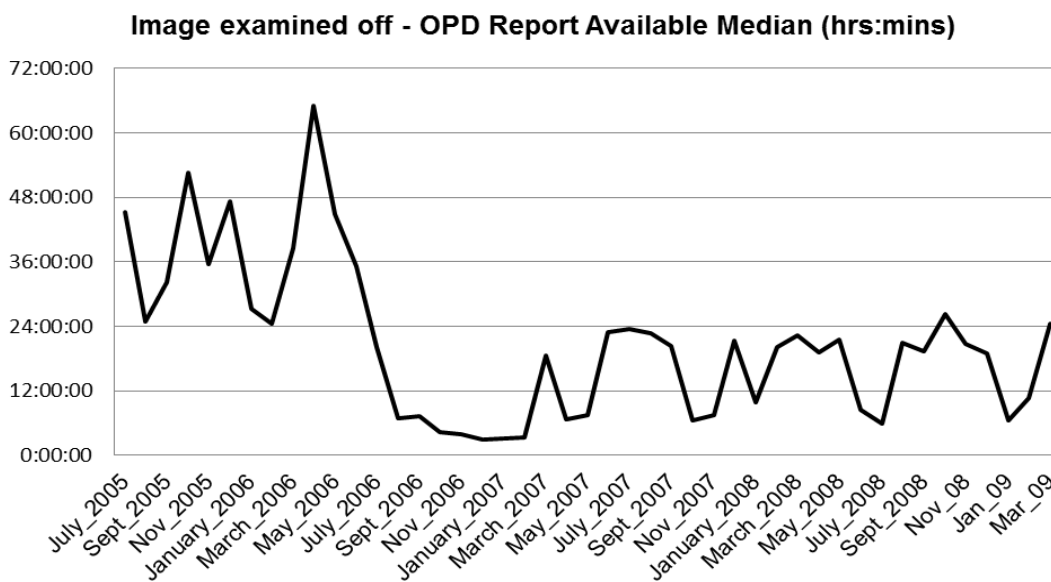
The development of a scorecard to present the data for the clinical indicators agreed upon was an important element in underpinning improvement activities. A component of the scorecard was the radiology department activity data. This was the easiest of all data to collate and is presented in graph 1 along with ED presentations to demonstrate the steady increases in workload at around 2% at the time of the project.



Graph 1 – Radiology Activity July 2005 – March 2009.



Graph 2: Image examined off to Inpatient report available - Interim reporting commenced in June 2005



Graph 3: Image examined off to Outpatient report available – Streaming of Reporting commenced August 15th 2005.

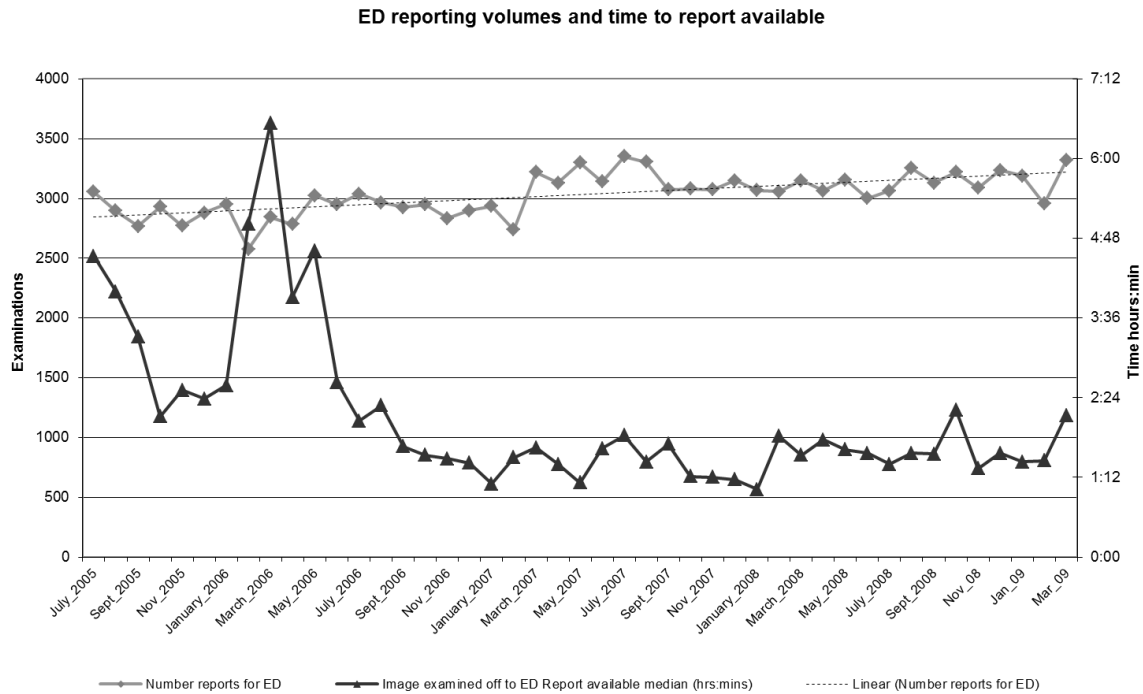
Report Availability

Process mapping identified three key delays for the release of reports. This included radiographer data entry, radiologist authorising reports and overnight CT reporting processes. Even though an image

had been reported via dictation, typists were unable to type reports as it required radiographers to electronically sign the completion of the examination which releases the information to the RIS before the image could be accessed. A number of

simple data elements required to be entered by radiographers on completing an examination was required before the image could be released for reporting. This was viewed to be cumbersome and process mapping highlighted that it did not actually

add value to the process. A decision was made to reduce the data that was needed to be entered by the radiographers to increase compliance with ‘examining off’ so the typists could access the image sooner.



Graph 4: Image examined off to Emergency Department patient report available – Digitalisation of reporting process completed in July 2005

Final authorised reports were available electronically via the hospital clinical information system or via the hospital patient management system. The unauthorised reports within the RIS were not available to be viewed by the hospital staff. The next phase of the change involved developing systems to enable the release of reports that had been dictated and typed but not authorised by the radiologists. This involved executive support to enable the release of Radiology Consultant interim reports for inpatients and emergency department patients and by Radiology Registrars for emergency department patients. A number of risk mitigation

strategies were implemented including visual indicators to reflect the status of the report, a hospital wide communication strategy detailing the change and a clear delegation of responsibility to the Radiologists to report to clinicians any clinically significant variations from the interim report to the authorised report. [14] This saw an immediate decrease in the time taken for reports to be available to clinicians from 48-49 hours to less than 1 day (as seen in graph 2).

Another disconnect was with the process of handwritten entries in the patient’s medical notes for reports generated by Radiologists overnight for emergency CT

Scans. These notes were inserted into various places within the medical record. A change was made to scan the comments or reports into the image archival system. This enabled the ED clinician to review these comments while they were reviewing the digital images. In addition Radiologists were able to review the notes made, contemporaneously with the examination, while reviewing the examinations with a supervisor in a convenient electronic format.

Digitisation of reporting

The existing reporting process was driven by paper based requests supporting digital images. The request form was used as a mechanism to check patient identification against image, provide clinical details and as a visual indicator to drive the work flow.

One idea generated from the process mapping was to digitise the process. The request form is scanned and then the request data file is linked to the image file. Whilst not necessarily the ‘best’ solution in the current technological era it was the best option available for the information systems the department had in operation. An electronic work list was created from the Radiology image archiving and communication system. This provided the Radiologists with access to the image and the request in one location. The work list also visualised the reporting demand and the waiting list of outstanding reports. It also facilitated patient focused reporting i.e. all images for one patient can be reported at the

same time. This has required some physical changes to reduce the number of viewing boxes (for which there were never enough) and increasing the electronic reporting workstations.

This change was supported by the construction of an interface using a serial cable between the digital dictation system and the image archiving and communication system (PACS) and used on the reporting station. This interface in the absence of a context interface obviated the need for Radiologists to manually enter data into the digital dictation system thus avoiding data entry errors.

All requests were able to be stored electronically. The removal of paper requests had an additional benefit in that paper requests no longer needed to be filed and stored as described in the retention and disposal schedule [15] and in turn freed up space and reduced filing time.

Re-streaming of the Reporting work

The next strategy involved re-streaming the reporting work flow. The department had two reporting rooms where images were reported based on the modality – one room for CT scan reporting and the other for general reporting. Activity data was used to facilitate streaming of reporting by reviewing the number of examinations per modality, by patient type and indicative reporting time. Based on data that is presented in Table 2 reporting workload for one month was reviewed.

Table 2: Example of how the distribution of patients examined by the Radiology Department by Modality and patient status was undertaken based on one month’s activity data.

	X-Ray	CT	Ultra-sound	Angio	Fluoroscopy	MRI	Mobile	Mammography	Chest clinic	Total
ED	563	87	15	1	1	2	1	0	0	669
In Patients	206	127	71	20	20	26	414	3	0	887
Out-patients	199	101	66	2	8	49	5	23	192	645
Total	968	315	152	23	29	77	420	26	192	2201

Using the volume data it was decided to stream reporting of images on the basis of patient type, one room was dedicated to ED patients and inpatients and the other room outpatient reporting. Reporting was based on individual patients and all images of different modalities were reported at one time. The ED/Inpatient room was the main room in the department enabling ease of access for clinicians and the OPD reporting room was sequestered facilitating ease of reporting of more complex studies relatively interruption free. There was some concern that the reporting of outpatient images may be delayed by streaming in this way but graph 3 shows there was an overall improvement of outpatient reporting times. This was achieved at the same time ED reporting times improved (graph 4).

In addition to reporting time improvement across all modalities the percentage of completed reports within our targets were also monitored. Graphs 2, 3, and 4 all demonstrate the improved percentage of reported images for ED patients, outpatient and inpatients. The percentage of inpatients with a report available within 24 hours has increased from 35% to over 80% (target 100%), outpatient's from 65% to 95% (target 100% within 7 days) and for ED patients from 20% to 60% within 4 hours (target 75%).

DISCUSSION

Redesigning radiology reporting processes has demonstrated significant improvements to service delivery. Focussing on across systems reporting processes has seen a significant decrease in the time for clinicians to access reports. A number of key factors have supported these improvements including strong clinical leadership, staff engagement, rigorous change management strategies and the measurement and monitoring of clinical indicators.

The targeted improvement work within radiology resulted from senior hospital clinicians identifying radiology as a barrier to discharging patients from the emergency department and increasing inpatient length of stay. There was high level executive support for the establishment of the Radiology Pathway including the work being chaired by the General Manager. Senior clinicians and managers within radiology were also supportive with the multi-disciplinary leads involved in all improvement activities.

A number of strategies were implemented to engage staff in the improvement process.^[5] Local improvement teams focused on targeted areas for improvement with key stakeholders invited to participate. All radiology staffs were invited to attend improvement meetings alongside nominated staff from all work disciplines within radiology. Staffs from outside the department were also involved on the teams. A large notice board was established to keep staff up to date and a monthly bulletin was attached to all staff pay slips.

Understanding change management processes was important to manage staff reactions to change.^[16] There were varying levels of resistance to the changes. There was a constant need for rigorous communication and marketing about new concepts to ensure all stakeholders were briefed. Trial periods went for six weeks to allow the first two weeks managing the resistance and the final four demonstrating good and not so good process changes.

The use of data was another important tool to managing the changes.^[16] Data was used in conjunction to the process mapping to understand the service. It was useful to articulate the current state of play. Data was useful to dispel legends about poor service delivery. Data was very important to explain to staff the significance a change

was going to have on their daily working lives and was pivotal in the evaluation of the level of improvement achieved.

Many organisations already have fully integrated digital technology to support their service. Digital imaging enables clinician's immediate access to images and ceases the requirement to provide soft copies. In turn the requirements of the referrer and user need to be given consideration in relation to accessibility to the image via the appropriate means, including adequate hardware and the right quality of image. Quality assurance of reporting needs to be built into software development as the transition from paper based systems occurs. An example is clinicians being able to acknowledge they have sighted results. Currently many organisations run digital imaging and reporting systems but still retain old practices ^[11] such as retaining hard copy reports in patient medical records. Poor integration of new technologies without proper workflow redesign limits the potential gains. ^[17]

The changes implemented through the Radiology Pathway have had a sustainable benefit. The initiative continues in focusing on improving patient access to the radiology department. The scorecard enables continual monitoring of current performance. This has resulted most recently in an expansion of the reporting service as data indicated this was required to meet the targets. Ongoing monitoring of peaks assists identifying underlying process problems such as outstanding unauthorised reports, guiding future improvement strategies.

Our next project using this methodology was the Emergency Department radiology pathway. This commenced in mid 2008 and a major piece of work was creating a data set that could reflect performance. Once data was available what we have experienced is a

13% growth in ED radiology examinations (Aug – Dec 2010 compared to Aug – Dec 2012) at the same time the weekly percentage of examinations completed from time of request to examination completed has increased from a range of 43-66% pre intervention and after intervention in 2012 65-80%.

Future directions for improved access to imaging include the transition to electronic requesting, the use of speech recognition software and streamlining and improving quality and safety systems for the reporting processes.

CONCLUSION

Patient imaging is an integral component of clinical care. Access to radiology services is often cited as a barrier to patient flow in acute services. Timely availability of images and image reports is considered important to underpin timely clinical decision making.

Many readers will have radiology departments that have first class information systems and world class technology but they do come with a cost. For many radiology departments they function with mismatched information systems that are not integrated and hamper service delivery.

The work undertaken at the Department of Radiology, Royal Adelaide Hospital demonstrates that the application of a systematic redesign methodology can significantly improve service delivery whilst maximising the available resources.

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