

Menu Case Study: Patient-Based Radiation Safety Program

Applicant Organization: Lakeland HealthCare

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Executive Summary

In 2008 Lakeland HealthCare (LRHS) created a patient-based radiation safety program to monitor the use of Helical computed tomography (CT). The aim of this program was to engage providers, patients, and radiologists, ensuring patients received well-coordinated care and avoid dangers potentially associated with the unchecked ordering of CT studies. This program only produced limited results.

With the implementation of an Electronic Health Record (EHR) in 2012, Lakeland re-launched a multi-faceted radiation safety program to ensure the safety of young adult and pediatric patients receiving radiation exposure for benign diagnosis. Since this program was introduced, 57 at-risk patients have been identified for monitoring and 26 CT studies cancelled or changed to a different exam with lower radiation exposure for these patients.

Background Knowledge

Lakeland HealthCare is a not-for-profit, community-owned system of care serving the southwest Michigan region of Berrien, Cass and Van Buren counties. Lakeland's leadership is committed to delivering exemplary healthcare at the best value which has led to a 100 Top Hospital award in national rankings. Our mission is to enhance health and serve our community.

Helical computed tomography (CT) has revolutionized diagnostic imaging by its ability to image with extraordinary speed and accuracy. As a result an unprecedented increase in the use of these studies has ensued. This rise in CT studies has led to a substantial increase in radiation exposure. An abdomen CT scan can expose a patient to a radiation dose of approximately 10mSv per scan. Comparatively, it would take roughly 500 chest x-rays to equal this dosage. A comprehensive approach was needed to educate and alert patients and providers to radiation dose estimates and risks surrounding the cumulative exposure that may occur in some patients.

A successful radiation safety monitoring program required an accurate method for identifying at-risk patients, monitoring them, automating real-time alerts and education for ordering providers and patients. This level of automation and real-time alerting could not be replicated with the manual process attempted in 2008. Lakeland's EHR implementation became essential in allowing the organization to achieve a new level of radiation safety.

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Local Problem Being Addressed and Intended Improvement

Prior to the EHR implementation, Lakeland created a patient-based radiation safety program through manual effort. Letters were then sent out to providers notifying them of the program and alerting them of at-risk patients. When a CT scan was ordered radiology technologists reviewed the number of prior CT scans that patients had completed. If the patient had reached the threshold the technician would call the ordering provider to notify them.

This program was not effective. Providers needed to keep the letters in front of them to remember the at-risk patients. As a result they often forgot and continued ordering CT studies. Additionally, technologist only reviewed charts after a CT order had been placed. At times, Patients were already present for their exam before being identified as at-risk. This process caused frustration among some providers and made technologists reluctant to contact providers that were more vocal in their displeasure.

With approximately 30,000 CT studies per year, the time for constant monitoring of patient's charts proved to be inefficient. It did not meet the safety requirements envisioned. Without automated reports and real-time alerting the effectiveness of the program and safety of the patients could not be guaranteed or determined. With the implementation of the EHR system the quality, efficiency and safety concerns could now be addressed in a proactive way.

Design and Implementation

Having observed a growing number of patients with multiple CT scans a need was identified to increase awareness and potentially decrease the number of CT scans for at-risk patients within the organization. When researching this issue the radiology director identified other organizations¹ that had implemented a similar program with some success. Through collaboration with the radiology department and EHR team the following process was created and presented to the medical staff for approval.

A Patient-Based Radiation Safety Committee was formed consisting of the Radiation Safety Officer (RSO), Chief Radiologist and Radiology Director. Alert thresholds were created based on the number of CT studies completed rather than measuring exact dosages because of the number of variables involved in this process.² The following three base criteria were used for identifying at-risk patients:

- Patient less than 40 years of age
- Benign diagnosis
- 5 CT studies of the neck, chest, lumbar spine and abdomen or abdomen/pelvis

A weekly report was created to capture additional information for patients that matched these criteria including previous CT scan types and dates, past diagnosis and patient history. The

¹ Birnbaum, Steven. "Radiation Safety in the Era of Helical CT: A Patient-Based Protection Program Currently in Place in Two Community Hospitals in New Hampshire" *Journal of the American College of Radiology*; Vol. 5 No. 6 June 2008

² Amis ES Jr, Butler PF, Applegate KE, et al. American College of Radiology White Paper on Radiation Dose in Medicine. *J Am Coll Radiol* 2007; 4:272-84

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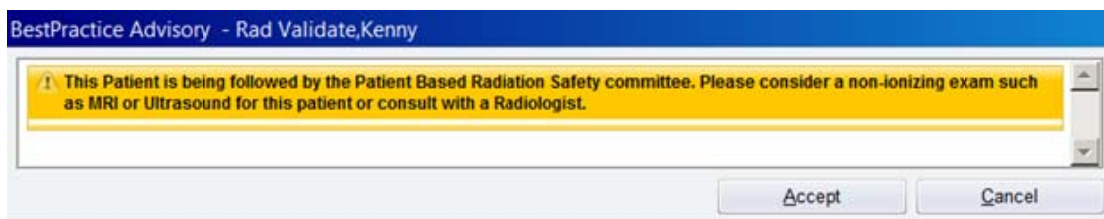
report also includes CT studies from external organizations based on the study type and body region entered when imported into Lakeland's EHR. This allows clinicians to consider the patient's entire radiation history when making decisions concerning potential risks.

Accession #	Exam Date	Procedure Ordered	Ordering DX
4848	RAD VALIDATE,JOHN	06/30/1997	
1469	11/10/2011	34653CT ABDOMEN PELVIS W CONTRAST	Pain
1470	11/10/2011	7476CT ABDOMEN PELVIS W WO CONTRAST	Pain
1471	11/10/2011	7480CT ABDOMEN PELVIS WO CONTRAST	Pain
1478	11/10/2011	132205CT ANGIO CHEST	Pain
1511	11/10/2011	33836CT LUMBAR SPINE W CONTRAST	Pain
1512	11/10/2011	33838CT LUMBAR SPINE W WO CONTRAST	Pain
1513	11/10/2011	33834CT LUMBAR SPINE WO CONTRAST	Pain

An initial review of the report is done by the Director of Radiology to identify potential candidates for the radiation safety program based on their medical and surgical history. These candidates are then reviewed by the Radiation Safety Committee to determine entrance into program. If a patient meets the criteria for the program a Best Practice Advisory (BPA) is added to their patient chart within the EHR. The patient's primary care physician will also receive a certified letter indicating the patient's inclusion in the program. The letter sent to providers indicates the following as a precaution rather than a requirement:

- Consult a radiologist before ordering any further radiographic examinations.
- Order a CT scan only when the benefits far outweigh the risks
- Substitute clinical evaluation for radiation-based imaging when possible
- Order alternative imaging with ultrasound, magnetic resonance imaging or conventional radiography when appropriate, feasible and indicated.

When an additional CT scan is ordered for this patient the ordering provider will receive a Best Practice Advisory alert stating, "This patient is being followed by the Patient Based Radiation Safety Committee. Please consider a non-ionizing exam such as MRI or ultrasound for this patient or consult with a radiologist."



The BPA does not prevent the ordering of CT scans and can be bypassed. If the patient continues to have additional scans and reaches a threshold of 10 CTs, three additional safety measures are taken.

1. The patient and provider will receive a certified letter notifying them that the 10 threshold has been met and of possible risks and benefits associated with CT studies.
2. The provider will be asked to consult a radiologist before additional imaging is ordered.
3. The RSO will also be made available for consultation with both the patient and provider.

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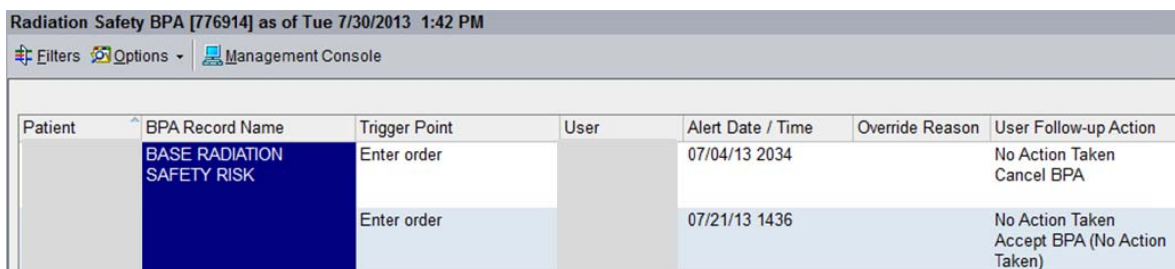
The program was launched with a meeting that included our Radiation Safety Officer, Radiology Director and Manager, Radiology Medical Director, ED Medical Director and Chief Medical Officer. The program was presented at that time in its entirety which included education related to the increased use of CT studies, the resultant radiation dose, and a review of data on patients who had received multiple CT scans for benign conditions. All questions and concerns were answered. The program was then presented to our organization's medical staff by the Radiology Medical Director. As CT dose reduction is of concern, many of the physicians were already aware of the need for such a program within the organization. Our ConnectCare team was available to answer all questions regarding the use of EPIC to track these specific patients digitally.

How was Health IT Utilized?

Prior to the EHR, Lakeland relied on a paper process to track at-risk patients. There was good intent but no sustainable way to make this program successful. In 2011 Lakeland implemented Epic System's EHR in our ambulatory and community offices with all inpatient hospitals going live in 2012. Through the use of the EHR reports were created to efficiently monitor the number and types of CT scans across all patients received within the Lakeland system.

Once a patient was enrolled in the radiation safety program, a BPA was attached to their electronic chart which automatically alerted any provider ordering additional CT studies for this patient. Prior to this real-time alerting, some patients would receive the CT scan before the provider could be notified. Assurance that this communication would be delivered to providers led to improved outcomes and greater safety of the patient.

With the implementation of the EHR system, the effectiveness of the program could also be measured. Reports were used to determine how many times a BPA had fired for patients enrolled in the program and what response was taken by the ordering provider as a result.



Patient	BPA Record Name	Trigger Point	User	Alert Date / Time	Override Reason	User Follow-up Action
	BASE RADIATION SAFETY RISK	Enter order		07/04/13 2034		No Action Taken Cancel BPA
	BASE RADIATION SAFETY RISK	Enter order		07/21/13 1436		No Action Taken Accept BPA (No Action Taken)

Value Derived/Outcomes

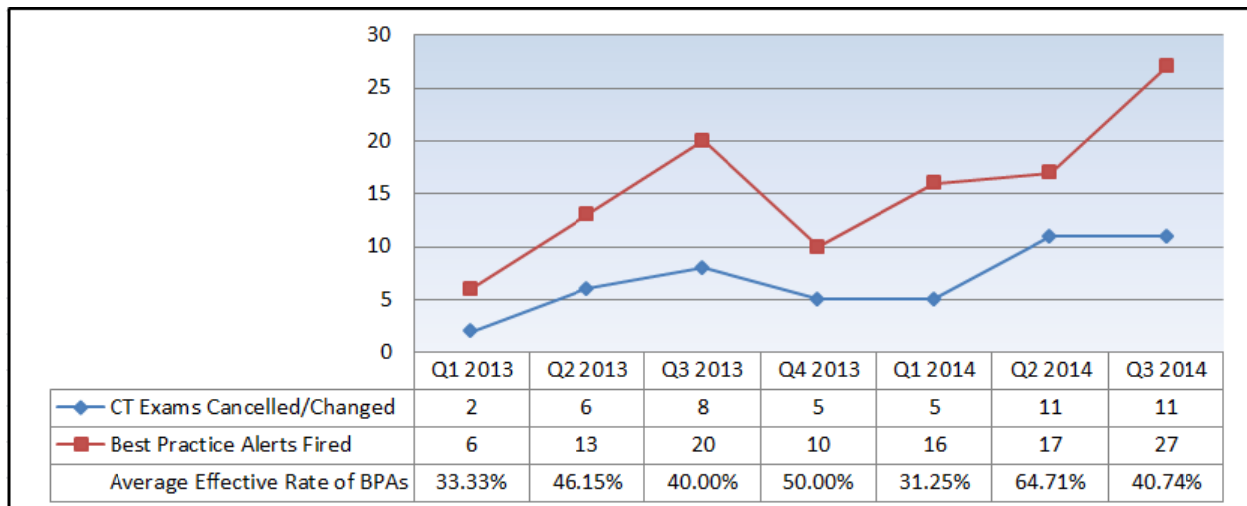
The goal of the radiation safety program was never to deny CT exams to patients. Rather, the aim was to increase awareness of both providers and patients to possible risks associated with radiation exposure. This would potentially decrease the number of CT exams ordered for at-risk patients when alternative imaging (ultrasound, magnetic resonance imaging or conventional radiography) was appropriate and feasible.

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The Patient-Based Radiation Safety Program launched in 2013 with a total of 9 patients. Currently, Lakeland has enrolled 57 patients in this program. A total of 57 letters have been sent to referring physicians for patients who have reached the 5 scan threshold and a total of 2 patient letters sent to persons completing 10 or more CT studies.

The initial outcomes of this program are very positive. A 17 year old male with 6 CT scans in a 6 month period (all scans essentially normal) had his next 2 abdomen and pelvis scans cancelled after enrollment in the program. A 30 year old female with 5 CT scans within a 3 month period (with no essential change noted from scan to scan) had her next 2 abdomen and pelvis scans changed to alternative imaging to include a simple radiograph or a non-ionizing ultrasound exam.

In the first quarter, the BPAs were 33% effective in triggering the ordering provider to cancel or select alternative imaging for patients enrolled in the radiation safety program. Over a year later the BPAs have a total average effective rate of 44% with a total of 109 occurrences of a BPA firing prompting 48 cancellations or change to alternative imaging orders.



This program has been met with high acceptance by patients, clinicians, and radiologists. Physician feedback has been very positive with some physicians being observed having conversations with patients informing them of the number of CT exams they have had and the potential impact. Currently, all CT technologists, providers and radiologists are actively participating in this program.

Lakeland has seen the awareness of potential risks associated with radiation exposure increase among its providers. Many of our ED physicians have begun identifying patients who do not meet the program criteria, but are still of concern. An example is a 45 year old patient who does not meet the age criteria but has reached the 5 exam threshold. Lakeland's providers have identified 5 such patients to date.

Lessons Learned

Real-Time Automated Notifications Are Necessary

Prior to the EHR implementation there was no method for notifying providers of at-risk patients as they were ordering CT studies. Technologists were tasked with calling physicians to alert them once the study had been ordered. This created two areas for possible communication failure. Ordering providers were often not notified in time and technologists might decide not to contact providers that were vocally resistant to the process on prior calls.

The Best Practice Advisory (BPA) alerts were the solution to these challenges. BPA alerts are triggered immediately on every CT study ordered for patients in the program. These prompt the provider to re-evaluate the decision and consider choosing another exam if appropriate. These notifications are also seen by all providers ordering CT studies ensuring that any prior communication gaps would be closed.

System Alert Fatigue

One of the concerns of implementing a real-time alerting system is that of alert fatigue. Very early on it was determined that criteria would be needed to only trigger alerts for patients that were truly at-risk. Alerts were to be used selectively so patient care would not be delayed or CT studies inadvertently withheld from patients where the risks outweighed the benefits. A report was created to identify at-risk patients who were less than 40 years of age and has received 5 or more CT studies of the neck, chest, lumbar spine and abdomen or abdomen/pelvis. These candidates were then reviewed by a committee for accuracy before adding the BPA.

Increased Provider and Patient Engagement

In order for a program to be successful, all personnel impacted must be involved and committed to its success. This program included input from the radiology department, radiologists, technologists, EHR team members, ordering physicians, and most importantly the patient. As a result, we have seen an increase in providers consulting with radiologists and patients becoming more involved in their own care through increased awareness and personal accountability. Providers are also notifying Radiology of potential candidates prior to them meeting program thresholds.

We have received feedback that when patients are included in the program, their provider is taking time to educate them on the effects of radiation and how they can be more engaged in their care.

Process Improvement Opportunities

Throughout the program Lakeland has continued to seek opportunities to improve reliability, quality and patient safety. One of the recent optimizations was the inclusion of external CT studies into our EHR system. These studies are then incorporated into the monitoring reports giving a more complete picture of the patient's imaging history while engaging them in the process.

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Financial Considerations

Developing the Patient-Based Radiation Safety Program did not consume additional costs, other than the time of the analysts, radiologists and providers involved in planning and building the required reports, workflows and alerts into the EHR system. Lakeland has an ongoing team dedicated to the optimization and support of the EHR system. This project fell within their scope of work for development, training and ongoing support.

Lakeland is dedicated to providing effective and affordable care to its patients. When providers cancel CT studies or choose alternative imaging when appropriate, feasible and indicated, they are ensuring these goals are being met. A patient receiving a US retroperitoneal complete instead of a CT Abdomen Pelvis with contrast would see a reduction in their health care cost of \$2312.

EXAM	COST
CT Abdomen Pelvis with contrast	\$2,755.00
US retroperitoneal complete	\$443.00
XR Abdomen/KUB	\$146.00

This program has contributed to an overall reduction in health care spending. With a total of 48 CT scans being cancelled or changed to-date, the cost of care has been reduced by \$72,424 (approx. \$1,508 per CT cancelled/changed).

With a projected 25% increase (per year) in patients enrolled in the safety program, Lakeland will provide a significant cost savings to the patient population in the years to come. At the current effective rate of the BPA alerts, patients will recognize a total projected savings of \$434,656 in 5 years and \$1,747,872 in 10 years.

The true return on investment is the decrease in patient dose since the inception of the program. The total estimated patient dose avoided is 820 mSv which is comparable to natural background radiation of 273 years.³ Projected dose avoided over 5 years is 3760 mSv and 15120 mSv in 10 years.

³ Estimated Patient Dose compared to [Natural Background Radiation](#)