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"Am I Going to Glow in the Dark?' An Analysis of the Overutilization of Diagnostic Medical Imaging

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“Am I going to glow in the dark?”:
An Analysis of the Overutilization of Medical Imaging

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Chapter 1: Introduction

Nature of the Topic

Diagnostic medical imaging is one of the fastest growing fields in medicine. In 1895, a radiograph of Mrs. Roentgen's hand took nearly 15 minutes to capture; that same radiograph today takes seconds. In the last 15 years, Lifespan has done its part in staying up to date with the latest in radiologic technology. From the original film screen imaging to the latest upgrade, a self-collimating digital system in Rhode Island Hospital's emergency department, the improvements have revolutionized how we utilize medical imaging.

Unfortunately, all great things come at a great cost. As of 2013, it is estimated that the cost of imaging studies nationally exceeds $100 million annually (Semelka & Elias Jr., 2013). In addition to the extreme financial cost, the improvements in medical imaging have resulted in a gross overutilization of the extremely valuable resource. The National Committee for Quality Assurance defines quality health care as "the extent to which patients get the care they need in a manner that most effectively protects and restores their health". In today's health care system, many patients are being subjected to over utilization of many of our medical resources. It is estimated that roughly 20%-50% of high-tech imaging, such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET), could be classified as "unnecessary imaging services" (Semelka & Elias Jr., 2013). Up to half of imaging exams performed do not provide any new and/or useful information. Unnecessary imaging can also lead to incidental findings that lead to a web of additional images and exams that are unrelated to the patient's chief complaint.

Purpose of the Research

It is the goal of this paper to raise awareness of the danger of overutilization of diagnostic medical imaging and present possible solutions to reduce the current number of imaging exams performed.

Significance

For patients, the risks of radiation exposure are not typically explained prior to imaging. As patients become increasingly more involved in their healthcare decisions, it is critical for them to be well educated on the risks and benefits of an exam before agreeing to imaging.

For providers, the ease of modern imaging has resulted in needless use of diagnostic imaging. There are currently no official appropriateness criteria regarding imaging at Lifespan, so the appropriateness is left to the discretion of the provider. Although the benefits of diagnostic medical imaging are unparalleled, it is also crucial that the provider consistently weighs the benefits against the risks.

Research Question

The data yields two major questions: why is this overutilization occurring and how do we fix it? In my thesis, I will be analyzing the overutilization factors as well as discussing the negative implications associated with unnecessary imaging. Additionally, I will be documenting the process and outcomes of a project at Lifespan titled *Shared Decision Making: Appropriate Use of Head and Back Imaging Tests.*

Chapter 2: Patient Information

Since the beginning of medical practice until as recently as the 1980s, the physician/patient relationship has been described as "paternalistic" (Semelka & Elias Jr., 2013). In this case, the physician functions as the sole decision maker with little objection from the patient. In modern history, the physician-patient relationship has shifted to a mutualistic relationship, a relationship in which the patient plays a much more active role in their health care decisions. The mutualistic relationship prevails in health care setting, particularly since the trend of verbal and written informed consent has become the norm. However, the paternalistic approach is still prevalent regarding diagnostic imaging.

In 2006, Yale conducted a study showing approximately 95% of patients are not given any information regarding radiation risk prior to their CT. As of 2013, studies had shown little improvement with the percentage dropping to 76% (Semelka & Elias Jr., 2013). After rotating through every radiology department at Rhode Island Hospital, I have seen first-hand many instances of patients not being properly informed about the risks and benefits of their radiographic procedures. I have walked into an inpatient room with the portable and been yelled at by a mother who could not understand why her child was receiving another imaging procedure. In fluoroscopy, patients come in without knowing they will be ingesting barium contrast. My grandfather has been the subject of over imaging over the last nine years following a cancer diagnosis and an unexplained loss of mobility in his legs. As a student and future radiologic technologist, it pains me to see these patients and their loved ones confused, angry, and scared.

On the contrary, some patients choose to do their own "research" on radiation using *Grey's Anatomy* and WebMD. These patients come to the emergency department and refuse a single x-ray out of fear of cancer, birth defects, and other extreme, long term effects of ionizing radiation. I have even had a child at Hasbro Children's Hospital tell me, "You know, this can give you cancer" during their chest x-ray.

It has yet to be determined whether low-dose ionization causes cancer; because of this, there is currently no "safe dose" of radiation (Sherer & Ritenour, 2015). Technologists practice the "as low as reasonably achievable" or ALARA principle and provide lead shielding whenever possible in order protect radiosensitive tissue during imaging. Despite these precautions, the patient has the right to know the risks associated with their imaging exam. Additionally, patients who are overly cautious regarding imaging should be educated on the valuable information that can be obtained from diagnostic imaging.

The average person is exposed to 625 mrem of background radiation every year from natural and man-made sources. Approximately 38% of the yearly dose is attributed to diagnostic medical imaging (Sherer & Ritenour, 2015). There is currently a chart available for radiologic technologists to help patients understand the amount of radiation for various procedures. The BERT (Background Equivalent Radiation Time) chart lists the doses for different radiographic procedures with the amount of time it would take to receive the same dose from background radiation. See chart below.

Radiographic Procedure	Dose in mrem	BERT
Dental	6	1 week
Chest	8	10 days
T-spine	150	6 months

L-spine	300	1 year
Upper GI	450	1.5 years
Lower GI	600	2 years

Even this seemingly minor piece of information could drastically alter patient perspectives on diagnostic imaging. Although radiologic technologists have tools such as the BERT chart, the responsibility of properly educating patients falls on the ordering providers. Every patient has the right to make an informed decision regarding their healthcare after weighing the risks against the benefits and that right must be extended to include diagnostic imaging.

Chapter 3: Literature Review

Clinical Decision Support

The American College of Radiology (ACR) is currently in the process of mandating a clinical decision support (CDS) system to assist providers in ordering imaging the adheres to the Appropriateness Criteria (AC) guidelines. This movement began in the 1990s when the ACR determined it necessary to provide national guidelines to prevent overutilization of diagnostic imaging (Schultz). Today, a panel of 10-16 members work to provide "the most comprehensive, evidence-based guidelines for diagnostic imaging selection, radiotherapy protocols, and image-guided interventional procedures" (Schultz, 2018). The current Appropriateness Categories table is listed below.

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually appropriate	7,8, 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients
May be appropriate	4, 5, 6	The imaging procedure or treatment may be indicated in the specified clinic scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio or the risk-benefit ratio is equivocal
May be appropriate (disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually not appropriate	1, 2, 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable

The ACR AC guidelines are fairly accessible. The American College of Radiology website features a link to AC ratings tables and narratives that allows providers to search topics and choose from various exams and procedures. Additionally, the link provides the appropriateness category rating, radiation levels, and alternative exams for different indications. The National Guidelines Clearinghouse posts the ACR AC guidelines on their website. The ACR also has an app available for download in the iTunes store. The ACR has also developed ACR Select, a software system designed to be integrated into electronic health record system to assist providers at the time of ordering. Despite all these avenues to reach the guidelines, many providers still refuse to access and utilize them (Schultz, 2018).

In 2014, Congress passed the Protecting Access to Medicare Act. The act instructed the Center for Medicare and Medicaid Services to require providers to consult a clinical decision support system. The deadline for hospitals to comply with the new regulations was January 1, 2017 but has been repeatedly pushed back; the current deadline is January 1, 2020. Hospitals and providers refusing to adhere to the new policy will not receive compensation for imaging exams performed.

Currently, Lifespan has a program called ACR Select operating “in the background” of the current ordering system. ACR Select is collecting data in order to provide a custom template for when ACR Select is put into practice or “goes live”. ACR Select has been in place at Lifespan since 2016 and has the hopes to go live prior to the January 2020 deadline.

ACR AC has received major pushback from providers nationwide. Because of this, many medical students and residents are not aware the tool exists. A study conducted in 2008 at the Department of Radiology at Boston University found 96% of medical students were unaware of

the guidelines. After partaking in sessions on the use of ACR AC, 94% of medical student found the ACR AC to be a useful resource and 89% anticipated using the resource in their clinical practice (Schultz, 2018). Although Lifespan is not experiencing major pushback from providers, the guidelines are still not well known. When emergency department physicians were asked about the guidelines followed when ordering imaging exams, the response was, "there are none".

Overutilization

As previously mentioned, there is a trend of gross overutilization of medical resources in today's healthcare environment. One of the primary causes is physician fear of litigation. Although this issue extends to nearly all aspects of healthcare, I will be focusing specifically on the overutilization of diagnostic medical imaging.

Advances in medical imaging have significantly improved how providers are able to detect and diagnose injuries and diseases. Additionally, modern medical imaging has made it possible to replace many surgeries with minimally invasive procedures guided by fluoroscopy. The use of diagnostic imaging today extends far beyond the x-ray room. The largest demographic group being referred for medical imaging are older adults. As the baby boomers age, this population continues to increase, therefore, resulting in more imaging orders. Although these scenarios may not be categorized as "unnecessary imaging", the excessive radiation being used continues to contribute to background dose. "Unnecessary imaging" is defined as any exam that fails to provide any new information to improve patient care; however, it is to be noted that negative imaging studies can influence future health care decisions. (Hendee, et al., 2010)

An article published in 2010 by the Radiological Society of North America outlines the major causes of over ordering of imaging exams. The first contributing factor is the overall

healthcare system in the United States. Currently, reimbursement is received for each imaging exam performed. The more imaging exams performed, the institution receives more revenue. A related factor is the issue of "self-referral" where the referring provider receives financial benefit from ordering imaging exams. In 2010, it was estimated self-referrals resulted in $16 million annually in unnecessary exams. Instances of over ordering due to self-referral are typically found in outpatient facilities and physicians' offices. (Hendee, et al., 2010)

One of the most prominent factors contributing to overutilization of diagnostic imaging is the practice of defensive medicine. In the United States, legal action against health care providers is commonplace. Due to this, the fear of possible malpractice accusations contributes significantly to providers' decisions to order exams, regardless of the benefit to the patient. (Hendee, et al., 2010)

The final factor is the limited and voluntary use of the appropriateness criteria. As previously discussed, appropriateness criteria are designed to help providers determine the necessity of imaging exams. Although this tool could greatly reduce the number of unnecessary images, many providers are unaware of the tool or believe it is not accessible. (Hendee, et al., 2010)

Radiation Protection

General knowledge of the danger of radiation has come incredible far since the days of x-rays being featured as a circus attraction. Exposure to radiation is known to cause damage on a cellular level. The effects of radiation damage can range from mild skin reddening to birth defects. Cells are vulnerable to radiation based on their maturity, specialization, and rate of

reproducibility. The results of radiation damage can be short term, long term, or genetic. Short term effects will appear days, weeks, or months after exposure to radiation. Long term effects typically take years to become apparent. Genetic effects occur when damage is done to a sperm or ova cells and the genetic mutation is passed on to the next generation. See chart below for list of short- and long-term effects (Sherer & Ritenour, 2015).

Short Term	**Long Term**
Nausea	Cancer
Diarrhea	Cataracts
Fatigue	Birth Defects
Hair loss	Permanent sterility
Temporary sterility	
Skin reddening	
Decreased blood cell count	

Due to the damaging nature of ionizing radiation, it is a radiologic technologist's responsibility to protect patients, personnel, the general public, and themselves from any unnecessary radiation. As previously mentioned, technologists practice the ALARA principle; this principle states a technologist will use techniques that are as low as reasonably achievable without compromising the quality of the images. This helps reduce both patient dose and background dose.

Background dose is defined as radiation received by the general population annually from both natural and artificial sources. As of 2006, diagnostic imaging is the largest contributing factor to artificial background radiation, accounting for 48%. The previous estimate of annual background radiation was believed to be 360mrem as of 1982; new data has shown the actual

background radiation to be 625mrem per year. The National Council on Radiation Protection has reported this dose is not associated with any level of harm (Sherer & Ritenour, 2015).

During diagnostic imaging procedures, technologists use specialized equipment to protect themselves and their patients from unnecessary radiation. One of the most commonly used elements of radiation protection is lead shielding. Lead aprons are used to shield radiosensitive organs such as the gonads and thyroids during exams and procedures. See chart below for additional equipment.

Equipment	**Purpose**
Lead curtain	Used in fluoroscopy to protect radiologist during procedures
Lead line doors	Prevent scatter radiation from escaping the diagnostic imaging room
Lead housing	Encases the x-ray tube to prevent leakage radiation from reaching patients or personnel
Filtration	Absorbs useless radiation and reduces patient dose
Collimation	Restricts the field of the primary x ray beam and reduces amount of skin exposed
Grids	Absorbs scatter radiation, reduces patient dose, and improves image quality

In addition to the daily radiation protection practiced by technologists, diagnostic imaging personnel are monitored using dosimeters. The dosimeter is worn by personnel and reports the amount of radiation the wearer has been exposed to over a given period of time. This practice is used to ensure working conditions are safe and personnel exposure remains safely below the annual effective dose limits.

As mentioned, there is no “safe” amount of radiation exposure. These precautions are in place to protect patients and personnel while performing exams. It remains crucial for providers to only order imaging exams that are deemed necessary.

Chapter 4: Project

Method and Procedure

Lifespan joined *Shared Decision Making: Appropriate Use of Head and Back Imaging Tests*, a nationwide project run by Vizient in 2017. Vizient is a corporation used for setting benchmarks in the medical field. At the start of the project, Vizient was working with twelve hospitals nationwide. The *Shared Decision Making* project is working to reduce the number of radiographic exams performed in emergency departments throughout the country.

The project at Lifespan began in August 2017 and was led by Jenna Bessette, an administrative assistant for Operation Excellence (OpX) at Rhode Island Hospital. By November, the team was meeting and worked to create a project charter and a SIPOC. The hospital then collected data on the percentage of diagnostic imaging exams for non-complicated headaches and non-traumatic lower back pain from January 2017 to December 2017 at each affiliate. The project looked at all patients 18 to 50 complaining of headache or lower back pain and found the percentage in each respective group that received X-ray, CT, or MRI.

Why now?

OpX Operational Excellence

	NPT ED	RIH ED	TMH ED	Total
CT/MRI Headache	35%	55%	47%	48%
CT/MRI Low Back Pain	16%	32%	26%	28%

Includes patients of all ages receiving either CT/MRI for headaches.
Includes patients 18-50 yrs. receiving CT/MRI/X-Ray for low back pain

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Overall, 48% of patients with headache complaints and 28% of patients with lower back pain complaints received diagnostic imaging.

(Bessette, 2019)

The goal of the *Shared Decision Making* project at Lifespan was to reduce the percentage of diagnostic imaging tests performed for non-complicated headache and non-traumatic lower back pain by 30%. The *Shared Decision Making* team sought to reach this goal by implementing a process to assist the providers in determining the appropriateness of imaging. The team consisted of radiologists, emergency medicine physicians, quality and safety coordinators, and the directors of Imaging, Emergency Medicine, and Emergency Imaging.

The primary reasons for this project were centered on patient care and health care costs. Reducing the number of diagnostic imaging exams performed would reduce the overall cost of care for an emergency department patient. Foregoing imaging would also reduce the length of stay in the emergency department and, in turn, reduce emergency department wait times. The final and most important reason for the *Shared Decision Making* project is reduce the amount of unnecessary radiation exposure to patients. Lifespan issued the following message regarding their involvement with the project.

"We aim to deliver health with care, by ensuring that the guidelines for the imaging of headache and back pain are followed consistently by ordering providers in the Emergency Department regardless of patient and provider preferences. This has the potential to improve patient safety by reducing radiation exposure and to reduce waste by eliminating unnecessary imaging studies."

The project at Lifespan began by determining the workflow in the emergency departments to determine when the decision for diagnostic imaging is made. After determining

workflow and pinpointing when unnecessary imaging orders occurred, the team brainstormed to determine why over order had occurred.

The causes for over ordering were broken down into three categories: people, policy, and equipment. The category with the most reasons associated with it was "people" so we added the subcategories "patients" and "providers". In total, the team determined 17 reasons for over ordering across the three categories. See chart below.

	People	**Policy**	**Equipment**
1	Patient pressure for imaging	Overall efficiency of system	Availability of past medical history
2	Lack of patient/provider communication	Time efficiency	Current ordering system
3	Referring provider insistence on imaging	Lack of guidelines	
4	Admitting provider insistence on imaging	Malpractice	
5	Lack of patient education on risks/ benefits	Fear of radiation exposure	
6	Time constraints		
7	Fear of malpractice		
8	Fear of patient complaint		
9	Repeat visits for same complaint		
10	Provider variability based on ACR guidelines		

Together, the team determined to importance of each factor on a rating scale from 1-5 for the policy and equipment categories. We turned to emergency room providers to determine the

importance ratings for the reasons categorized under “people”. We sent out a survey listing each reason with the prompt, “On a scale of 1-5 with 1 being ‘not a factor’ and 5 being ‘an important factor’, how would you rate each of the following criteria in your decision as to whether to order imaging for headache or back pain?”. Fourteen providers responded to the survey. See chart below.

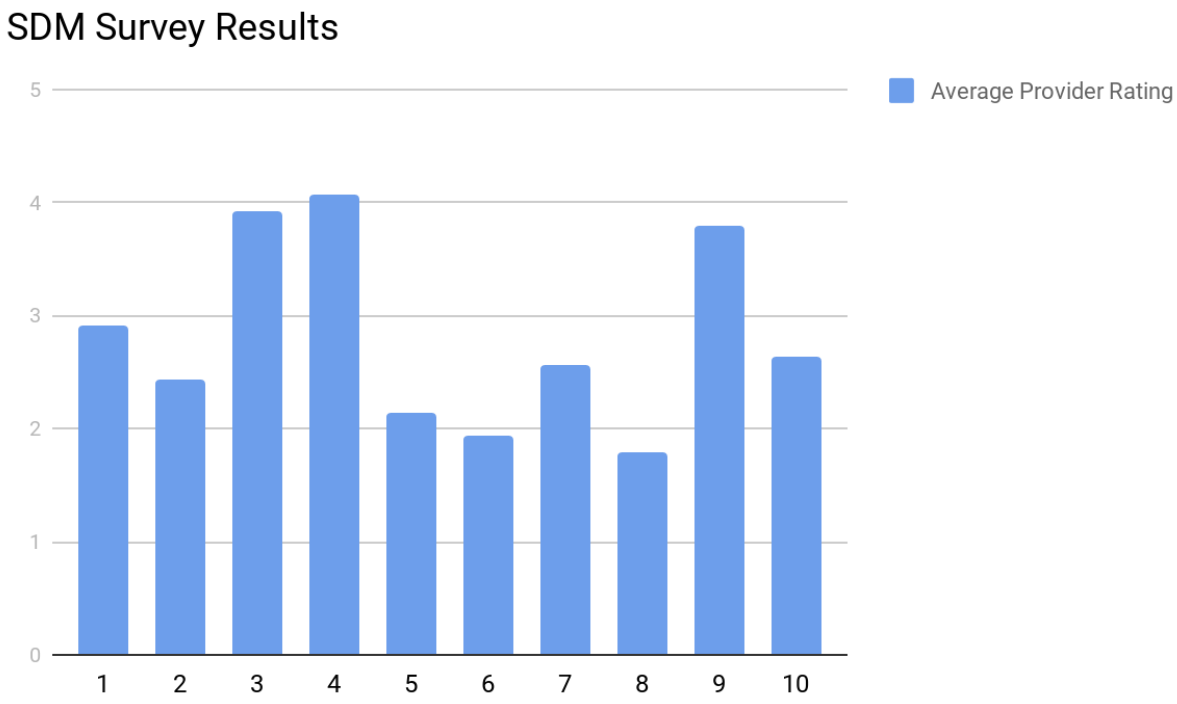

Figure 1: x-axis numbers correspond with the "people" list in previous chart.

Following the survey, the team multi-voted and determined the top six reasons for over ordering in the emergency department.

Referring provider insistence on imaging	Admitting provider insistence on imaging	Repeat visits for same complaint
Lack of guidelines	Overall efficiency of system	Availability of past medical history

The team then completed a Failure Modes Effects Analysis (FMEA) chart. Using the process steps, we determined opportunities for failure and the possible causes and outcomes. Additionally, we listed current controls in place to prevent each failure and ranked each in severity, occurrence, detection, and risk priority number. From the chart, the team determined the top five "potential Xs" or opportunities for failures to occur. See chart below.

Failure Modes Effects Analysis (FMEA)

Failure, Effects and Mode Analysis

Process Step	Potential Failure Mode	Potential Failure Effects	Severity	Potential Causes	Occurrence	Current Process Controls	Detection	RPN
ED Providers assesses the Patient	Language Barrier	Incorrect medical history	7	Lack of interpreting Services	2	Interpreter Services in all Affiliates (Insight)	5	70
	Insufficient Time to evaluate patient	Sub-optimal evaluation of severity of symptoms-	5	Volume Surges, excess holding of ED due to	10	Surge Plan. / Diversion	9	450
								0
								0
								0
								0
ED Provider Orders Diagnositc Imaging Tests	Ordering unnecessary tests	Over-radiation, contrast reaction	6	Overall pressures. Malpractice; patient, through-put.	5	Reportion Imaging Utilization	4	192
		Time delay, prolonged LOS	6	Patient surge	5	Reportion Imaging	4	192
		Incidental findings that may need follow up	6	Excess radiation	5	Reportion Imaging Utilization	4	192
		Unnecessary charges for 1) patients 2) hospital 3) Insurance companies	6	Increased cost for patient, hospital and insurance companies	5	Reportion Imaging Utilization	4	192
		Increased risk of errors	6	Resources maximized	5	Reportion Imaging Utilization	4	192
	May not order necessary tests	Delay in diagnosis	9	Pressure to reduce imaging	5	Data and individual case feedback	4	180
		Increased acuity of disease	9	Pressure to reduce imaging	5	Data and individual case feedback	4	180
		Possible exposure to litigation	9	Pressure to reduce imaging	5	Data and individual case feedback	4	144
Imaging Test Is Performed and Interpreted	Imaging is interpreted incorrectly	Wrong diagnosis	10	Lack of sub-specialization skills	4	Attending Providers over-read residents	1	20
		Additional imaging performed	5	Poor image quality	2	Daily Equipment QA	1	10
		Patient dissatisfaction	7	Time Constraints	6	Residents have maximum work hours per week	2	84
		Delay in care	6	Provider fatigue	3	Residents have maximum work hours per week	2	36
		Unnecessary radiation	3	Interruptions	6	Attending Providers over-read residents	2	36
		Repeat ED visit	3	Time Constraints	6	Attending Providers over-	1	45
								0

(Bessette, 2019)

The next step in the process was implementing rapid cycle changes. The first two rapid cycle changes involved altering the ordering indicators for head CT scans and lower back x-rays. These changes were made April 5, 2018. These changes were made in response to provider

complaints regarding the ease of finding indicators when ordering studies. This change was made to limit the amount of free texting used by making the more commonly use indicators readily available during ordering.

The next step was to determine the critical X's out of the list of the potential X's listed below.

Potential X's
Admitting / referring provider insistence on imaging
Time constraints
Repeat visits for same complaint
Past medical history not available

To do so, a null hypothesis and an alternative hypothesis were determined for each potential X. Using chart review, Chi Square tests, and sample tests, Ms. Bessette was able to calculate a p-value for low back pain and non-complicated headache which would determine whether to accept the null or alternative hypothesis. See charts below.

Data Collection Plan

Potential X's	H_0- null hypothesis	H_a- alternative hypothesis	Tool	Conclusions	Critical X?
X1- Admitting/ Referring providers insistent on imaging (C&E)	Referral patients and patients waiting to be admitted **DOES NOT** impact ordering for low back diagnosis and uncomplicated headaches	Referral patients and patients waiting to be admitted DOES impact ordering for low back diagnosis and uncomplicated headaches	Chart review for sample of 30 patients of low back pain and uncomplicated headache (30/each) from August – October 2018 Chi Square Test	Low Back Chart review concluded 3/30 patients were imaged due to referral status Accept the null **p-value = 0.547** Uncomplicated headache Chart review concluded 8/30 patients were imaged due to referral status Accept the null **p-value = 0.712**	No
X2– Time Constraints could not be measured					No

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Data Collection Plan

Potential X's	H_0- null hypothesis	H_a- alternative hypothesis		Conclusions	Critical X?
X3- Repeated visits for same complaint (C&E)	Repeated ED visits for same primary complaint **DOES NOT** impact diagnostic ordering for low back or uncomplicated headache	Repeated ED visits for same primary complaint **DOES** impact diagnostic ordering for low back or uncomplicated headache	Chart review for sample of 38 Emergency Department patients with primary complaint of low back pain or uncomplicated headaches from August – October 2018 Chi Square	Low Back Chart review concluded 6/20 repeat patients received imaging Accept the null **p-value = 0.547** Uncomplicated Headache chart review concluded 7/20 repeat patients received imaging Accept the null **p-value = 0.077**	No
X4- Past Medical Imaging History Availability	Having available past imaging history **DOES NOT** impact ordering new imaging	Having available past imaging history **DOES** impact ordering new imaging	Chart review of sample of 30 Emergency Dept patients with primary complaints of low back pain or uncomplicated each (each) from July -Oct 2018 1 sample t test	Low Back Chart review concluded. Reject the null **p-value = 0.000** Uncomplicated Headache Chart review concluded. Reject the null **p-value = 0.000**	Yes

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(Bessette, 2019)

Time constraints were unable to be a part of this process due to uncontrolled variables such as July 2018 Labor Action, diversion times, staffing variations, and equipment variables. Out of the potential X's able to be measured, not having access to a patient's past medical history was the critical factor in over ordering of imaging exams.

To combat this, Ms. Bessette implemented a final process change. Triage nurses are now required to ask patients about past imaging and document the patient's answer in Epic. Additionally, Rhode Island Quality Institute now requires past medical imaging to be documented on a state wide level in patients' electronic medical records. Although Lifespan may not be able to view the images from other hospitals or outpatient sites, it will be documented as of December 2018.

Limitations

The project faced many obstacles from the start and Ms. Bessette struggled to implement the changes required to meet our goal. The Vice President of Medical Imaging and Rehabilitation, Todd Cipriani, had initiated the project to prepare Lifespan for the launch of ACR Select to meet the CDS standards effective January 2019 [2]. As previously discussed, hospitals not complying with the CDS standard will not receive reimbursement from Medicare for services provided.

Mr.Cipriani appointed the team of radiologists, physicians, department directors, and quality assurance staff. Ms. Bessette had initially wanted a more diverse team including emergency department nurses and radiologic technologists to gain a clearer understanding of the entire patient care process in the emergency department, from admittance to imaging. However, the additional staff were deemed unnecessary and the project proceeded.

The second limitation faced early on was a severe lack of provider support. The majority of emergency department providers were overwhelmed by the amount of options when ordering and typically would opt to "free text" or manually enter the indications for imaging. "Free texting", unfortunately, is unable to be tracked; therefore, we are unable to deem the appropriateness of the indication. CDS will serve as a guide to determine the appropriate exam based on chosen indications. Although the new system is designed to aid the provider in image ordering, providers have deemed the software "not user friendly" and have made claims that it hinders the ordering process.

Despite the initial challenges, the project progressed forward. After creating the cause and effect diagram and determining the cause and effect matrix, we discovered the ordering software itself was not the primary issue. When it became clear that external entities were the driving force behind the unnecessary imaging, the project very suddenly lost support from leadership.

When the time came to initiate a rapid cycle change, Ms. Bessette suggested workflow changes to verify the necessity of imaging with the radiologist, a similar process to the current ordering system for MRI. Additionally, Ms. Bessette had hoped to provide pamphlets upon admission to the emergency department to educate patients about the benefits and dangers of radiation and offer alternative solutions. Both suggestions were shot down due to not wanting to upset the currently workflow of the providers.

Results

The project with Vizient ended in December of 2018. At the conclusion of the project, Ms. Bessette presented Rhode Island Hospital's data to the board at Vizient to be compared to the other participating hospitals. The usage of each modality is listed below.

X-ray	CT	MRI
↓ 20%	↑ 19%	↑ 4%

The other participating hospital was able to achieve decreases in exams for all modalities for lower back pain and uncomplicated headache. They achieved their goal by issuing pamphlets to patients and putting an emphasis on peer and patient education when making imaging decisions.

Although Lifespan did not reach their goal of decreasing the amount of imaging exams being performed across the board, there were variables that were not taken into consideration during this project. The variable believed to have the greatest impact on our results was the closing of Memorial Hospital in Pawtucket, RI in January 2018. The closing of Memorial has resulted in an influx of patients to Miriam hospital, as it is less than 4 miles from Memorial.

Chapter 5: Conclusion

Our healthcare system has evolved to rely on diagnostic medical imaging to the point where the risks and consequences are no longer being taken into consideration prior to ordering exams. We live in a time where patients have more influence in their healthcare decisions than ever before. Patients have the right to know all risks and benefits associated with all indicated procedures and that right must be extended to diagnostic imaging.

Although radiologic technologists do all they can to practice ALARA and provide appropriate shielding whenever possible, the responsibility of educating the patients falls to the providers. During my time working with the providers at Lifespan, it has become clear that time constraints and ease of ordering have established an efficient routine for providers. Unfortunately, in this case, “efficient routine” does not equate with “quality healthcare”. Providers have become accustomed to this routine and are resistant to additional steps that would validate the necessity of many imaging exams.

To conclude, our healthcare system is in need of an ethical reform. Hospitals and providers are pressured to have high a patient turn over and receive reimbursements for as many exams as possible. As a result, imaging is ordered as a preliminary exam in order to expedite their emergency department stay. If we were able to shift the focus from high turnover and reimbursements back to caring for our patients, we could have a drastic effect on overutilization of our medical resources.

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