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# Do Radiologists, Radiology Administrators, And Radiology Technologists Believe There Is Over Utilization Of Cat Scan And Mri Exams And If So What Do They Recommend To Ameliorate The Issue?

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DO RADIOLOGISTS, RADIOLOGY ADMINISTRATORS, AND RADIOLOGY  
TECHNOLOGISTS BELIEVE  
THERE IS OVER UTILIZATION OF CAT SCAN AND MRI EXAMS AND IF SO  
WHAT DO THEY RECOMMEND TO AMELIORATE THE ISSUE?

By:

Joseph M Gonzales

A Master's Thesis Presented in Partial Fulfillment  
Of the Requirements for the Degree  
Master of Science, Health Service Administration

Regis University

May 05, 2011

FINAL APPROVAL OF MASTER'S PROJECT

**HSA696 MASTER'S THESIS**

I have **READ AND ACCEPTED**

the Master's Thesis by: Joe Gonzales

Student Name  
Joe Gonzales

Title of Project  
Do Radiologists, radiology administrators, and radiology technologists believe there is over utilization of CAT Scan and MRI exams and if so what do they recommend to ameliorate the issue?

Submitted in partial fulfillment of  
requirements for the  
Master of Science in Health Services Administration  
degree at  
Regis University

Primary Research Advisor:

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Date: May 2011

## Abstract

*Objective:* Purpose of this study was to assess the opinions of Radiologist, Radiology Technologist, and Radiology Administrators, as to their belief if CAT Scan and MRI are over utilized, to determine if there are best practices in place if there is overutilization, and set the basis for future studies.

*Methods:* After analyzing several methods, it was determined the most appropriate way to understand what individual's thoughts are, and what they are doing was to reach out to the above groups using a descriptive survey. A survey using the Website [www.surveymonkey.com](http://www.surveymonkey.com) was created to investigate the opinions of radiologists, radiology administrator, CAT Scan and MRI technologists on the utilization of CT and MRI, and to find what their organizations have put into place to help resolve the problem. The survey was distributed via e-mail by the AHRA to its current and past members of approximately 9000.

*Results:* The data was collected from 380 respondents to the 14 question survey. The majority of the respondents were radiology administrators, radiology directors, or radiology managers with 58% of those respondents working in non for profit hospitals. The mean CAT Scan volume was 2400 exams per year, 66% of those surveyed said that volume has increased over the past five years. The mean MRI volume was 8589 with 62% of respondents saying MRI volume has increased over the past 5 years. The majority 62% felt that these imaging modalities are over utilized in the United States, while 45.7% felt they were over utilized in their own organizations. 58% said they did not have anything in place. Of those who did have a program in place 49.9% were using ACR criteria 83.6% said they have heard of ACR criteria. Organizations were putting

programs in place due to concerns of radiation exposure and health care cost concerns. 88.3% were concerned with radiation exposure in CAT Scan.

*Conclusions:* The awareness of overutilization is out there, however many are choosing to do nothing at this time. The most common best practice is using ACR criteria to guide decision making. Radiation concerns and health care cost are driving factors in reducing over utilization.

### Acknowledgments

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## Chapter 1. Introduction

In 1946, independently from each other, two scientists working in the United States described a physico-chemical phenomenon which was based upon the magnetic properties of certain nuclei in the periodic system (EMRF, 2009 para1). Today we know this technology as Magnetic Resonance Imaging or MRI. In 1980 there were approximately 12 machines installed in the United States. Currently there are approximately 11,000 machines installed in the United States, which is forty six percent of the machines installed worldwide (EMRF, 2009 para 2) Cost of an MRI can range from approximately \$1,000,000 to \$2,000,000 without any additional items.

In 1967 Godfrey Hounsfield developed the EMI scanner, named after the lab he was working for, today that system is known as a CAT Scan or CT scan (Hounsfield). It is estimated that three million CAT scans were performed in the United States in 1980. More than sixty- two million CAT scans per year were performed in the United States during 2007 (Colombia University, 2007). The average cost of a whole body CAT Scan is six hundred to three thousand dollars (Scan directory.com). When this technology was developed a whole body scan didn't even exist.

All the above information leads to the formal question, "Do radiologists, radiology administrators, and radiology technologists believe there is over utilization of CAT Scan and

MRI exams and if so what do they recommend to ameliorate the issue?" Health care costs are increasing faster than inflation and wages, and more of those costs are being passed on from employers to employees (Singer, 2008). Many indices of health care effectiveness show that the United States fares very poorly in comparison to other developed capitalist countries (Singer 2008). Almost all the other developed capitalist countries have universal health care with all their citizens being insured. Their per capita costs are also much lower, approximately \$3,000 annual per capita in Canada (Singer 2008). Costs continue to skyrocket, to the point many people can no longer afford healthcare. Are these two expensive tests part of that problem?

According to consulting firm Booz Allen Hamilton, medical imaging is the most expensive health care technology and plays a huge role in rising health care costs in the US, behind only prescription drugs. Not only that, it is a ballooning sector, too, growing at three times the rate of other services in health care (Chow, 2008). As stated above there are numerous machines being installed throughout the United States at a price of five hundred to one and a half million for a CT scanner, and one to two million on average for a MRI. For hospitals and outpatient imaging centers that have purchased these units, should be getting a return on their investment. Bigger hospitals have more than one or even two of each of these machines. This again leads to the question whether they are being over utilized, to pay for the cost of having them.

First generation CT scanners took 5 seconds to take one image. Currently that speed has increased to 0.05 seconds on new generation 64 slice CT scanners. The technological advances

are increasing at extraordinarily rapid rates. Information such as this raises the counter question is the technology improving or are there just more uses?

This topic has been looked at from a physician's perspective on what the advances are and how the technology is helping diagnoses patients faster and easier. Not many studies have been done from a hospital administrators perspective regarding the costs associated with exams, equipment and utilization increases with this technology. As healthcare costs continue to grow and healthcare reform starts to take shape, high cost imaging procedures may have to be monitored more closely. CT scans have been growing at ten percent a year while the US population is growing at less than one percent (Gardner, 2009). This data appears to be concerning for the growth of this modality alone. Emergency room physicians may be at the epicenter of the surge in scan use, twenty five to forty percent of CT scans being ordered in the Emergency Room (Gardner 2009). This raises the question of why is this test being ordered so frequently by these physicians. Is it convenience, fear of being sued, or pressures from the patients? We live in a world of technological advances. The public is more informed with the use of internet and other communication devices. How much does this influence what is being ordered? Part of the reason for this study is to find out if this technology is being abused by the patient, the doctor, or administrators. Or has this technology really changed so much that the benefits of the new capabilities are worth the utilization and costs associated with the exams.

The results of this study may have an impact on decisions made regarding the purchasing of equipment and the ordering of exams. As stated above, these exams costs anywhere from several hundred to several thousand for a CT and even more for an MRI. Sometimes not only

one but several of these exams are ordered at a time. Or a CT is ordered and then an MRI is ordered on the same body part. Thus far only financial implications have been discussed, but over utilization of these exams could also have an impact on the patients overall health.

Radiation is the primary technology used in CAT scan. X-ray was discovered in 1895 by German physicist Wilhelm Roentgen (1845-1923) who was experimenting with a Cathode ray tube. As a complete accident he discovered what is known today as the x-ray (UIC, 2009). Soon after the discovery of X rays Clarence Daley assistant to Thomas Edison, became the first recognized American fatality with both men repeatedly exposing themselves to x-rays in demonstrations and experimentation. X-ray burns on Mr. Daley's hands turned cancerous, spread through his body and eventually turned fatal (Nucs, 1998). The number of CT examinations performed in ED patients has climbed to alarming levels in recent years with this number far exceeding the growth of ED patient volumes (Nunez, 2009). Americans were exposed to more than seven times as much ionizing radiation from diagnostic medical procedures in 2006 than they were in the early 1980s. The increase over the past quarter century puts the cumulative national medical exposures on a level with natural background radiation exposure. The largest part of the increase in medical exposure was from computed tomography (CT) scans, amounting to almost one-half of the imaging exposure, and nuclear cardiac scans, amounting to one-fourth of the current total ( Schauer, Linton, 2009). MRI has only been around for thirty years. Even though it has been said it is not dangerous, it is still too early to prove there are no long term affects. For these safety reasons it is a very important topic of discussion regarding whether we could be causing more harm than good to the patient.

Data gathered on this topic indicates over utilization of the equipment. However the cost associated with this potential over utilization is not completely know. Many administrators probably have a good idea on the usage, but may not have an idea on the amount of negative exams ordered. If the United States has forty six percent of all units installed worldwide it raises the questions on how these exams really are affecting our healthcare costs.

Some administrators may see this equipment as a way to make money; others see them as a hindrance because they have to justify purchasing the expensive equipment while trying to keep up with the demands on the physicians, and patients. Doctors may see them as a way to make their life easier. Patients see them as either an exam that will give them a cure all, or a scary test that is going to hurt them. The equipment manufactures see them as a big opportunity for financial gain, and a technology to develop further. The technologist sees it as a job opportunity, an opportunity to learn a specialty that will in turn give them a higher salary.

Health care administrators are constantly faced with the dilemma of where to budget money, and have to make sure that money is being spent properly and in conjunction with the mission and vision statements of the organization. With expensive technologies such as CT and MRI there are several dilemmas for the healthcare administrator, do they continue buying all this expensive equipment, or do they spend the money elsewhere? If they spend the money in other areas will the competition leverage their outdated technology against them? One of the purposes of this study would be to find out the opinions of those involved in making the above decisions. Not only the financial aspect but to also find out if people actually incorporate any of the ethical factors in the decision making process. Do they let the doctors drive the decision, do they listen

to the patient's needs, or is it all based on the finances? In the end the outcomes intended would be to add some additional information in the decision making process of equipment purchases, and understand the opinions of those who have to make these decisions.

## Chapter 2. Literature Review

### *Overview of Problem and Research Question*

The problem is Computed Tomography or CAT Scan, and Magnetic Resonance Imaging or MRI is being heavily utilized in the United States. As the volumes increase and the amount of scanners increase, these two radiology modalities become more accessible for physicians to order scans, and ultimately help them diagnose and treat medical issues. Generally this would be considered a positive outcome of increased and advanced technology. However, the United States is considered to be in a healthcare crisis (Singer 2008). Healthcare costs are skyrocketing with no end in sight (Singer 2008).

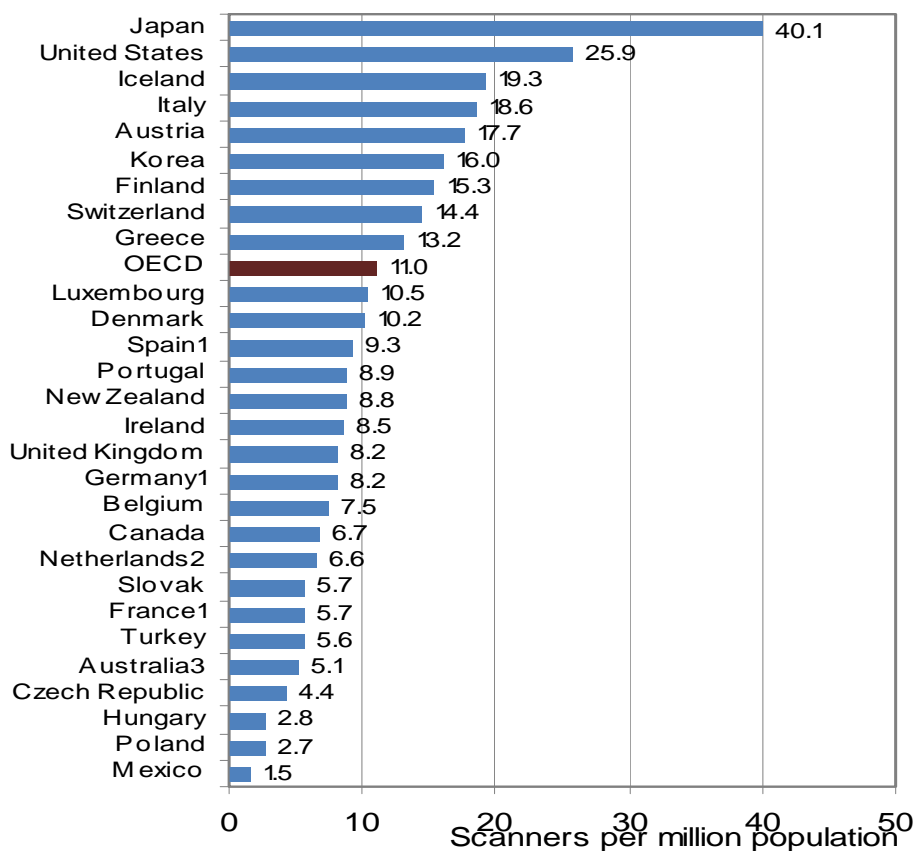
As stated in chapter one, these two modalities have a big impact on health care costs. This is just one of the many problems associated with heavy utilization of these two modalities. The formal question is, “Do radiologists, radiology administrators, and radiology technologists believe there is over utilization of CAT Scan and MRI exams, and if so what do they recommend to ameliorate this issue?” In order to fully study the above stated problem and the contents encompassing the problem, chapter two literature reviews will include the following: 1.) number and volumes of scanners in the United States, 2.) costs associated with utilization of CAT Scan and MRI, 3.) radiation effects of CT usage, 4) what is currently being done to resolve the problem? Finally, the reason behind this particular study and what the intended outcomes will bring to the future of Radiology and healthcare.



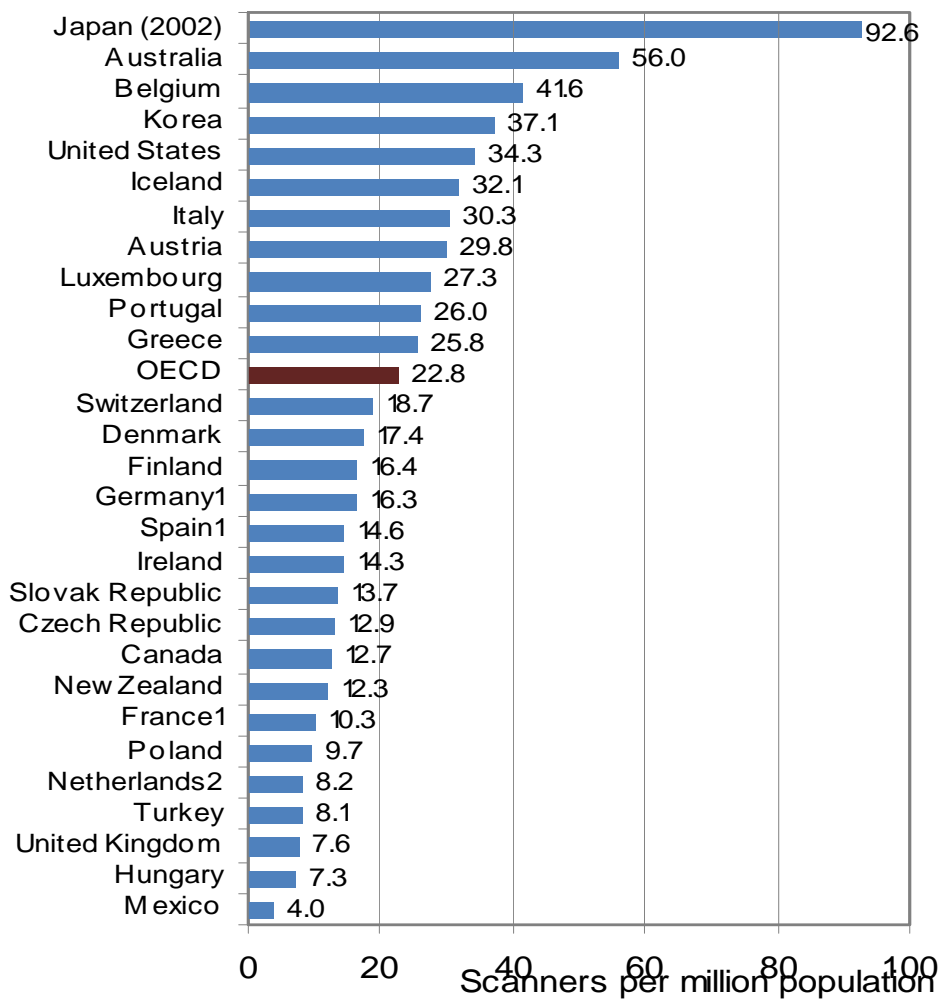
### *Number and Volumes of Scanners*

The number of CT and MRI scanners in the United States is second to Japan in the amount of scanners per million people (4.2.1 and 4.2.2, OECD 2009). Graph 4.2.1 shows the United States having 14.9 million more MRI scanners than average; this is second highest to Japan who had 14.2 million more MRI machines than the United States in 2007. Graph 4.2.2 shows the United States having 33.2 million more CAT Scan machines than the average, again only second to Japan who had 36.6 million more machines than the United States in 2007.

#### *4.2.1 Number of MRI units per million population, 2007.*

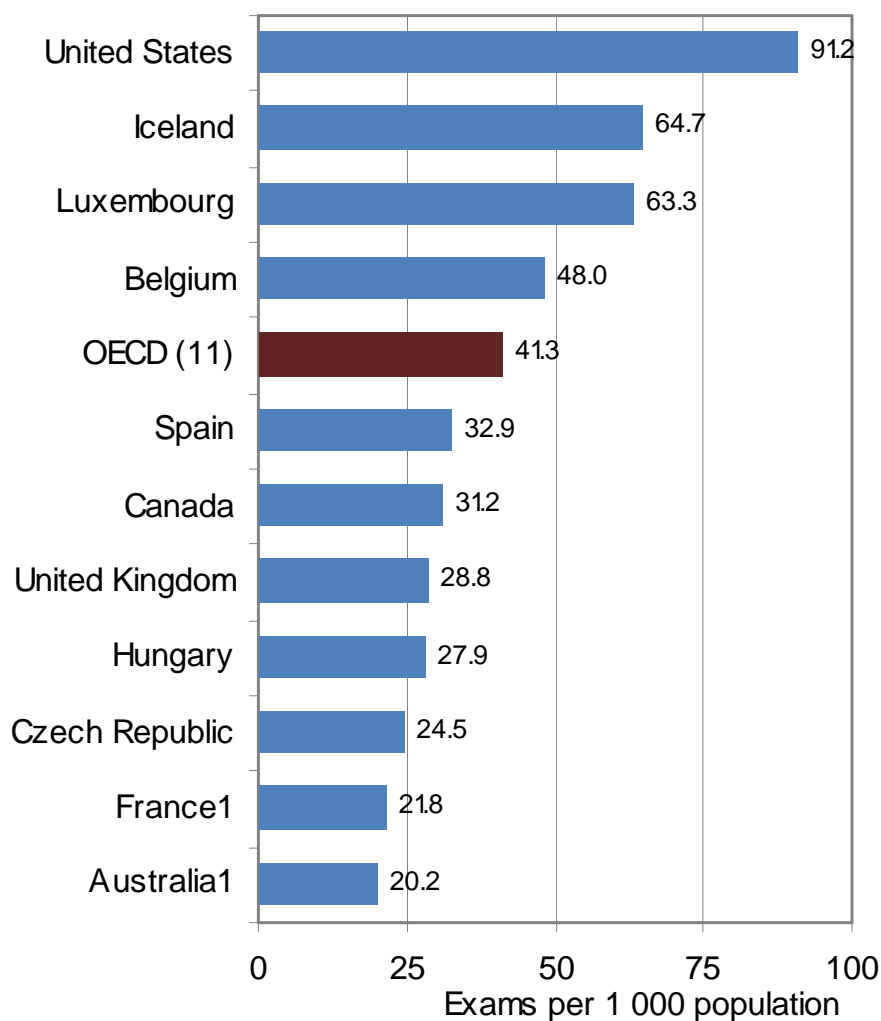


4.2.2 Number of CAT Scan units per million population, 2007.

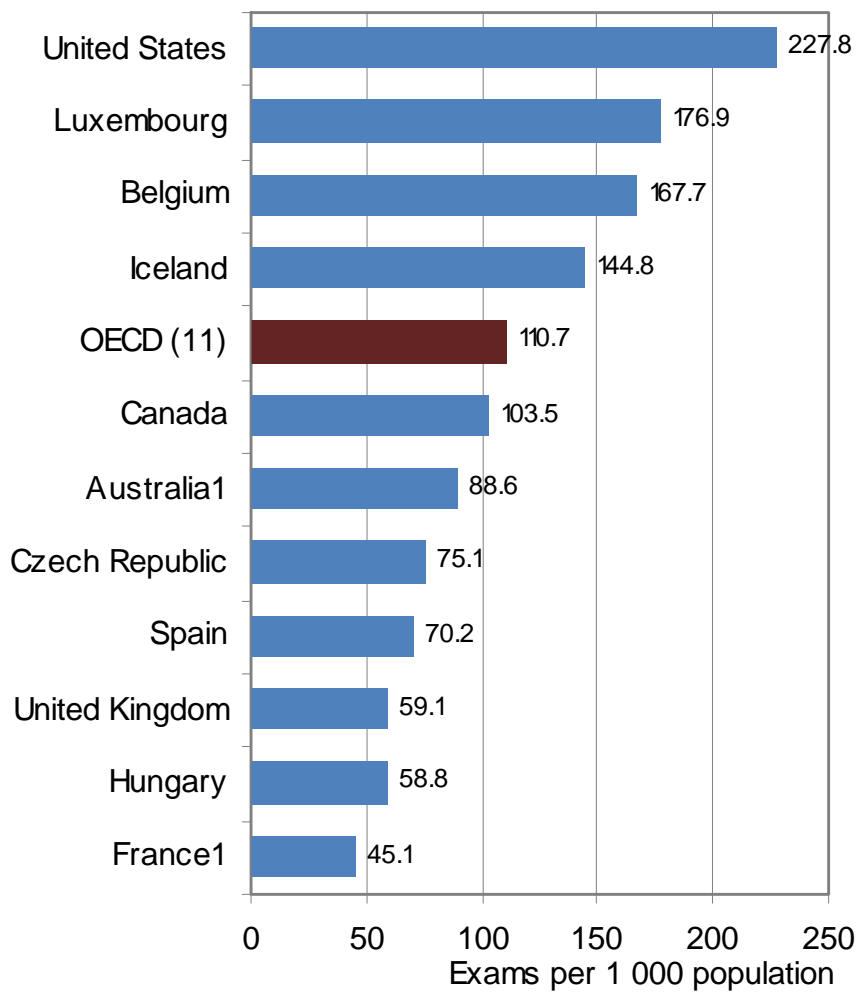


The United States ranked first in the amount of CT and MRI exams per 1000 population (4.2.3, 4.2.4 OECD 2009). Even though Japan had more MRI scanners than the United States in 2007, the United States was performing the most exams. Graph 4.2.3 represents the United States performing 49.9 more MRI exams per 1000 population than the average. ). Even though Japan had more CAT Scan machines than the United States in 2007, the United States was performing the most exams. Graph 4.2.4 represents the United States performing 117.1 more CAT Scan exams per 1000 population than the average.

#### 4.2.3 Number of MRI exams per 1000 population 2007



4.2.4 Number of CAT Scan exams per 1000 population.



Tables 4.2.1-4.2.4 show a trend in the United States of large quantities of machines and large amounts of utilization of these two imaging modalities

The increasing clinical utility of new radiologic studies such as CT and MRI, coupled with the greater availability of and capacity to perform these studies, has resulted in dramatic increase in their use over the past several decades (Matin, Bates, Sussman, Ros, Hanson, Khorasani, 2006). Some people believe that high technology imaging tests have not replaced conventional radiologic studies in the diagnostic workup but instead have supplemented them, leading to unwarranted increase in the number of imaging studies (Khorasani, Goel, Ma'luf, Fox, Seltzerl, Bates 1998). Several studies have been published over the past few decades regarding trends in radiology exams. Most have shown increased rates in CT, MRI, and other advanced modalities such as Nuclear Medicine. These trends started to be recognized in the early eighties when there was only a hand full of MRI machines installed in the United States. The oldest study found relating to this phenomenon was published in the American Journal of Roentgenology in April of 1998 written by Khorasni et al. Most articles site his original work in comparison to current trends, and use his work as a benchmark for gathering data.

The Khorasni et al. study used all admitted patients to Brigham and Women's Hospital from October, 1983 to September, 1993. The data were gathered using the Health Care Financing Administration case mix index based on DRGs to account for changes in severity of disease in the inpatient population during the study period. The unadjusted number of admissions each year was multiplied by the average case mix index of admissions in that year to produce the number of case-mix adjusted admissions or CMAs. They evaluated changes of radiology workload using RVU's which is short for relative value unit which is a dollar amount that is assigned to each encounter, procedure or surgery, developed by the Health Care Financing

Administration (Khorasani et al, 1998). The results were a significant increase in number of admissions and imaging studies. However there was a decrease in number of imaging studies per CMA and average length of stay. No significant RVU changes took place in the RVU per CMA per year during the study, although RVU components started to increase significantly over last years of the study (Khorasani et al, 1998). The number of CT examinations per CMA increased more than twofold during the study period, and the number of MRI exams increased six fold over the last year of the study. The final outcomes showed a decrease in imaging studies as a whole per CME however there were significant increases in CT and MRI studies. The Khorasni study set the foundation for further research in utilization.

Another study was done between 1993 and 1998 at Harbor View Medical Center. Harbor View is a 350 bed level one trauma center with annual volumes of more than 15,000 hospital admissions, 275,000 outpatient and mental health visits 65,000 emergency department visits, more than 170,000 imaging procedures as of 1999 (Henley, Mann, Holt, Marotta, 2001) . The group attempted to replicate the method of Khorasani for inpatients and expanded it to outpatients and Emergency room patients (Henley et al., 2001). The results showed an increase in inpatient admissions of 17%. Outpatient visits increased 20%, and emergency room visits increased 4%. The RVUs for imaging studies increased 53% for inpatients, 69% for outpatients and 85% for emergency department (Henley et al., 2001).

After accounting for case mix there was no significant increase in inpatient imaging. Nor after adjusting for number of outpatient visits was there a significant increase. After accounting for the number of emergency department visits there was a significant increase in RVU's over time (Henley, et al., 2001). For the inpatient group CT increase by 32%, MRI increased more

than two fold to 128%. After adjusting for case mix MRI remained significant (Henley et al., 2001). On the outpatient side CT increased 90% MRI increased 83%, and after adjusting for number of outpatient visits trends remained significant in MRI and sonography (Henley et al., 2001). The emergency room showed no change for MRI, and CT increased more than twofold. After adjusting for number of emergency room visits the CT usage was still significant (Henley et al., 2001). In contrast to the Khorasni study, the Henley study showed an increase in use of imaging studies. Just like the Khorasni study it showed strong trends in the increase in MRI for inpatients. It also showed an increase in use of MRI for outpatients, and significant increase use of CT for Emergency room visits.

The theories in the Henley study believed the drivers for increased usage of these modalities were systematic advances in treatment and diagnoses, increased number of illness associated with aging populations, technological advances leading to changes in practice patterns with increased reliance on diagnostic procedures to diagnose, stage and follow-up on therapies of patients. Secular changes such as societal expectations for rapid and accurate diagnosis, and provider's fear of litigation have also increased the propensity for imaging (Henley et al., 2001).

Yet another study using the same techniques of RVUs and CMAs was used to evaluate inpatient data on a 721 bed tertiary care institution between October, 1993 and September, 2002. The purpose of this particular study was based on the evidence presented in the above mentioned studies. The authors wanted to know if they had decreases in total radiology volumes during a ten year period as did Khorasni et al, and Henley et al,. They used the same formulas and data gathering methods as the Khorasni et al. study, the only difference is they used the most recently published RVUs'. Once again they found significant increases in the total annual number of

imaging studies and number of admissions. Once the CMA mix was added to the equation it showed a significant decrease in imaging studies as a whole (Matin et al., 2006). The amount of conventional x-ray studies and sonograms per CMA per year decreased significantly. Nuclear Medicine studies increased by 37%, the number of CAT Scans increased by 83% (mostly in the latter half of the decade), and the number of MRI studies per CMA increased by 167% (Matin et al., 2006). Relevant outcomes of this study were significant decreases in conventional radiology and ultrasound exams and significant increase in CT scan and MRI exams. It also showed an increase of RVUs' per CMA, technical was 32.4%, professional was 10.6% and global was 28% (Matin et al., 2006). When Matin et al compared the increase in Nuclear Medicine, CT, and MRI there was a 62% increase from 1993 to 2002 (Matin et al., 2006).

These three studies were all done independently of each other, during different decades, and in different institutions. Yet all seemed to have similar trends of increased usage of MRI and CT examinations. However the study done by Henley et al. only showed an increase in MRI volumes for inpatients, and it showed a significant increase in the use of CT scan for emergency room patients. All three studies used similar data collection methods and used RVUs and CMAs for data relevance. By using the same methods it made the outcomes and trends more valid for comparison. Another similarity was the increase in usage of MRI in the latter years of the studies. When grouped together these three studies help validate the increase usage of CT scan and MRI and show a continued upward trend of usage through the decades.

The previous three studies show trends in individual institutions, which leads to the question of whether they are just isolated incidents or if this is occurring on a larger scale?



*Utilization from a global perspective*

Three more studies were found on utilization rates among the Medicare population. Medicare reimbursement accounts for approximately one third of all medical services in the United States (Maitino, Levin, Parker, Rao, Sunshine et al., 2003). The next three studies reviewed captured the Medicare and Medicaid populations, and were done around the same time frames as the three prior studies. The first study was done from 1993 to 1999, and published online by Radiology in 2003. The purpose of the study was to determine utilization rates and nationwide trends for noninvasive diagnostic imaging among the Medicare population (Maitino et al., 2003). They took Medicare part B claims data files from 1993, 1996 and 1999 and analyzed all procedure codes related to NDI (non-invasive diagnostic imaging) and separated them into 22 different imaging Categories, as well as seven imaging modality groups. The data was analyzed to determine the overall nationwide utilization and RVU volume and rate changes in the utilization rates and RVU rates between 1993 and 1999 for the Medicare fee for service population, which included approximately 33 million enrollees per year (Maitino et al., 2003).

The results from 1999 showed conventional radiology being the most utilized imaging technology 55.5%, followed by ultrasonography at 20.5%, computed tomography at 8.8%, mammography at 2.6%, and bone densitometry at 1.5% (Maitino et al., 2003). In the six year interval from 1993 to 1999 the rate of NDI utilization increased 3.8%. The utilization rate for conventional radiography decreased 13.7%, while that of all other modalities increased a combined 39.1%. During the six year period, RVU rates per 100,000 increased 14.6% with RVUs' for MR imaging increasing 76.6%; those for nuclear imaging 38.7% those for CT 28.3% and those for ultrasound 24.2% (Maitino et al., 2003). The more significant find was a 14.6%

increase in RVU for imaging studies during the same time frame. In comparing the findings to the previous studies similarities exist in imaging procedures decreasing slightly, staying the same or increasing in small increments. But the big difference is the shift in more radiology exams being performed in more advanced modalities, in particular MRI 76.6% increase in this study in. The previous studies did more adjusting for case mix and probably had more advanced statistics, because the numbers were pulled institutionally and were looked at on a smaller scale. However if looked at from either perspectives the trends are consistent.

Another study that looked at similar statistics in the same time frame was done by Livstone, Parker, and Levin. This group looked specifically at MRI angiography and body MRI for the Medicare population between 1993 and 1998. Their purpose was to determine trends in utilization of the above mentioned MRI exams and trends in non-radiologists participation in MRI imaging, and the relative reimbursements for these examinations compared with those for all other noninvasive imaging studies performed in 1998 (Livstone, Parker, Levin, 2002). As the Maitino, et al study, the Livstone et al group pulled their information from the Medicare part B data.

The utilization rate per 100,000 Medicare beneficiaries for all 21 MR angiography and body MR imaging codes increased from 649 in 1993 to 1,253 in 1996 and to 1876 in 1998 which is an overall 189% increase. These rates represented .55% of the total noninvasive imaging volume in 1998 and 2.8% of physician reimbursements. Musculoskeletal MR imaging utilization increased 142% from 1993 to 1998 compared to a 58% increase in the utilization of other MR imaging studies. Non radiologist participation in musculoskeletal MR imaging increased from 2.9% in 1993 to 3.6% in 1996 and to 5.6% in 1998 (Livstone et al., 2002). In summary MR

angiography and body MR imaging utilization rates increased substantially from 1993 to 1998. However these studies still account for a minor fraction of all non- invasive imaging examinations performed and fees reimbursed (Livestone et al 2002). MR angiography and musculoskeletal MR imaging utilization has increase rapidly. Non-radiologist participation in musculoskeletal MR imaging is increasing (Livestone et al 2002). This particular study used CPT-4 codes instead of RVUs' which would change the weighting and the percentage rates in comparison to all the other studies reviewed. However it still shows similar trends and takes it a step farther with identifying trends in particular increases in musculoskeletal MRI exams and the increase of non-radiologists participation in musculoskeletal MR imaging.

A more current study done on the topic of utilization was done in 2001, and published in the October 2005 issue of Radiology. The purpose of this particular study was to assess the most recent available data for levels of and trends in utilization of radiology procedures across populations, modalities and geographic areas (Bhargavan, Sunshine, 2005). They used claims data from Medicare part B enrollees for all radiology procedures. They also used the Medical Expenditures Panel Survey (MEPS), a nationally representative survey of almost 25,000 Americans, to calculate population based utilization for the relevant age groups. Their results from 2001 showed 4176 diagnostic and 274 therapeutic radiology procedures were performed per 1000 Medicare non-managed care enrollees. Nearly one half of diagnostic procedures involved radiography. The other half involved all other modalities including CT, MRI, Ultrasound, Nuclear Medicine, Interventional Radiography and Mammography. On average between 1998 and 2001 utilization per Medicare enrollee increased 16% for MRI and 7% to 15% per year for CT, Ultrasound, Interventional Radiology and Nuclear Medicine. In contrast

utilization for radiography as a whole only went up 1% (Bhargavan et al., 2005). The conclusion was utilization of high-technology modalities increasing rapidly, while that of radiography was relatively stagnant. Variation in utilization among states and census region was substantial (Bhargavan et al 2005). This study used numbers from the Medicare data on exams performed whereas the other studies also compared CPT-4 codes or RVUs' for the procedures performed. This study was done a few years later than the previous studies but still shows the same trend of conventional radiology staying stagnant and continued usage of advanced modalities, with large increases in MRI.

All the fore mentioned studies took different approaches, study populations, data sets, study settings, decades, data gathering and data reporting in examining utilization of radiology services. They all came up with similar trends of traditional radiology exams being stagnant, decreasing in small increments, or increasing in small increments. However they all showed increases in advanced modalities in particular MRI and in many instances CT.

*Economical concerns associated with increased utilization of MRI and CT examinations.*

There are concerns that the inappropriate use of imaging may contribute to rising health care costs (Matin et al., 2002). The previously mentioned studies indicate a change in the usage of newer imaging technologies over conventional radiographs. Decreasing their inappropriate use should be a priority in efforts that focus on controlling imaging expenditures (Matin et al 2002). This raises the question of what these costs mean. What are the implications of shifting to these more advanced modalities as it relates to the costs associated with doing so? The current cost of a one view chest x-ray in the Los Angeles area is \$109 to \$150, the cost of a chest CAT

Scan (non- contrast) in the same area is \$1,137 to \$2,253, the cost of a chest MRI (non- contrast) in the same area is \$3,478 to \$11,383 (My medical costs.com 2010). The above numbers show increasing costs from lower technology to price of more advanced technology. The amount paid for all non -invasive imaging examinations in 1998 was \$5,081,543,417 (Livestone et al., 2005). The amount paid for MR angiography and body MR imaging in 1998 was \$145,434,332 (Livestone et al., 2005). The Maitino et al study showed a 14.6% increase in the RVU rates between 1993 and 1999. In dollar terms Medicare spending for imaging services paid under the physician's fee schedule grew over 60%, from \$5.7 billion in 1999 to \$9.3 billion in 2003. Beneficiary spending on these services has also increased, both directly through co- payments and indirectly through increased part B premiums (Miller 2005). The above findings require more research to be done on the economical concerns of increased utilization of CT and MRI. Not many current articles were found on this particular topic even though almost all papers reviewed thus far have recognized that it is a concern in the rapid growth of healthcare costs.

Another study that was done compared MRI imaging in Japan to the United States. The purpose was to compare the utilization and costs of MRI imaging systems in Japan to the United States (Hisashige, 1994). In reference to graphs 4.1.1 and 4.2.1 above Japan has the most MRI and CT units in the world with the United States being second. Mr. Hisashige mailed a questionnaire to all 746 medical facilities in Japan that had MR imaging units. The questionnaire included the characteristics of the facilities and the MR units, the utilization of MR imaging, and selected economic issues. The response rate was 57%. The results were compared with those reported for the United States (compiled from another study). The results showed that the total number of patients examined each year per MRI was 56% of that in the United States. The

average charge for MRI in Japan was \$200 which is one fifth of the United States. The average purchase price for an MR unit and the annual cost of MR imaging in Japan were \$1.6 million and \$713,500, respectively which were lower than those in the United States at \$2 million and \$412,000 respectively. The annual number of examinations per unit required to break even financially in Japan was higher than the actual number of examinations done (Hisashige, 1994). In conclusion, the average number of MR examinations per unit in Japan is about half that in the United States, and the fee for MRI imaging in Japan is one fifth that in the United States. Most MRI imaging systems in Japan income generated by imaging falls below the break- even point. A typical MR unit in the United States has an estimated net profit of \$535,000 (Hisashige, 1994). One of the important points from this study is the last point made; the United States is making a profit on the MRI machines installed as far back as the early 1990s when data was gathered for this study. If the concern is the impact on healthcare costs, the money from the profits made must be going somewhere. This therefore raises a concern around appropriateness of the studies being performed and increased utilization of these modalities. Another important point is that the United States appears to be charging more for these exams than other countries, which again may be having an impact on the overall healthcare spending. In 1982 the MR units in the MRI operated at a \$400,000 dollar loss and by 1990 they were showing average profits of \$500,000 (Livstone et al., 2002). Either these organizations became much more efficient, or the usage of the equipment increased significantly, or the equipment became less expensive. .

As CT and MRI technology has advanced, there has been an absolute explosion in utilization of these techniques. This has driven the cost of these services to the point where these techniques are now under scrutiny by managed care, Medicare, Medicaid, and employers

(Forman, 2006). According to Forman the passage of the balanced budget act in 1997 allowed for better hospital based reimbursements, which then lead to a little more money to spend on capital. The advancement in speed, new uses and faster diagnosis enabled CT and MRI to be a good choice in where to spend the money. Another major reason for the boom in imaging facilities was the rewards of investing in new imaging facilities. According to Forman, in the past decade there have been fewer “sure things” than an imaging facility. Investments in imaging centers have been very profitable (Foreman, 2006).

Medicare spending for imaging services paid under the physician’s fee schedule grew over 60% from \$5.7 billion in 1999 to \$9.3 billion in 2003. Beneficiary spending on these services have also increased, both directly through co- payments and indirectly through increased part B premiums (Miller, 2005). As discussed above, CT and MRI are major contributors to the increase of this spending. The above statement by Miller was in a report from Medicare Payment Advisory Commission or Med PAC on recommendations of imaging services in March of 2005. Med Pac is a group of advisors to congress on Medicare issues, and Miller is the Executive Director of Med Pac.

*Radiation concerns with increased utilization of CAT Scan.*

CAT Scan is only a part of the imaging utilization problem. However the concerns associated with CAT Scan may be greater due to, CAT Scan being an ionizing radiation producing machine. CAT Scan becomes a greater concern if a person has scans done on multiple body parts or has many follow up exams. Another concerning area is some of the new uses such as coronary angiography. Up until this point everything discussed has been related to exploring

the utilization of CAT Scan and MRI and the costs associated. This section will shift to CAT Scan, and MRI as it relates to the individuals health and well-being.

In 2006, Americans were exposed to more than seven times as much ionizing radiation from medical procedures as was the case in the early 1980's, according to a new report on population exposure released in 2009 by the national council on Radiation Protection and Measurements or NCRP (Schauer, Linton 2009). In 2006, medical exposure constituted nearly half of the total radiation exposure of the US population from all sources. The increase was primarily a result of the growth in the use of medical imaging procedures in particular CT and Nuclear Medicine. These two medical imaging modalities alone contributed nearly 36% of the total radiation exposure and 75% of the medical radiation exposure of the U.S. population (NCRP Report 160). CAT Scan amounted to almost one half of all imaging exposure (Schauer et al., 2009).

Calculations of radiation doses get very complicated and can be very confusing. However it is important to understand the types of effects CT utilization is having on radiation exposures to the public. CT based diagnosis in adults is the largest population being exposed. About half of the diagnostic CT examinations in adults are scans of the body and about one third are of the head, with about 75% obtained in a hospital setting and 25% in a single practice specialty setting. The largest increases in CT use, however, have been in Categories in pediatric diagnosis and adult screenings (Brenner, Hall, 2007). These increases in pediatrics can be quite concerning due to the risk associated with immature cells being exposed. The estimated amount of CT studies performed in pediatric 6% to 11% (Brenner, et al 2007).



Organ doses from CT scanning are considerably larger than those from corresponding conventional radiography. For example a conventional x-ray examination of the abdomen results in a dose of the stomach of approximately .25mGy which is at least 50 times smaller than the corresponding dose of an abdominal CT (Brenner. et al 2007). In any terms 50 times smaller is a significant amount and raises concern. The increased utilization raises concerns whether there are too many CT exams being performed in the United States. There is a considerable amount of literature questioning the use of CT, or the use of multiple scans, in a variety of contexts including management of blunt trauma, seizures, and chronic headaches and particularly use as the primary tool for appendicitis in young children (Brenner. et al 2007). Pediatric radiologists suggest that perhaps one third of CT studies could be replaced with alternative approaches or not performed at all (Brenner. et al 2007). This leads back to the formal question; if these radiologists who know about this are doing anything about it?

In a recent study of radiologists and emergency room physicians about 75% of the entire group significantly underestimated the radiation dose from a CT scan and 53% of radiologists and 91% of emergency room physicians did not believe that CT scans, increased the lifetime risk of cancer (Lee, Haimes, Monico, Brink, and Foreman, 2004). This group came to this conclusion by surveying adult patients seen in an academic medical center during a two week period, who came in with abdominal-pelvic pain and received a CT scan. They asked the patients if they were informed about the risks, benefits and dose of the CT scan and asked if they believed the CT scan increased their risk of cancer. Patients were also asked to estimate the dose of radiation in comparison to a chest x-ray. The ordering physician and the radiologist who read the exam were asked similar questions along with their years in practice. In addition to the above

results no patient, emergency room physician or radiologist were able to accurately estimate the dose of radiation compared to that of a chest x-ray (Lee et al., 2004). As stated above radiation dose is really hard to figure and there are a lot of factors that need to be taken into consideration to get an accurate dose. The concern is the physicians ordering this exam do not have an understanding of the exposure rate, nor do the radiologists who are supposed to be able to consult on this matter. It appears the patients trust the physicians to know what they are exposing them to.

A separate study was done to define a conservative estimate of the number of patients undergoing repeat or multiple emergency department CT studies to help quantify their cumulative CT Radiation doses and lifetime attributed risk of developing cancer (Griffey, Sodickson, 2008). They took all adult patients who had repeat visits and repeat CT scans on each visit within a one year time frame. They took all diagnostic CT studies over the previous 7.7 years and calculated cumulative dose, they then came up with a dose to risk conversion factor of one cancer to 1,000 patients receiving a 10mSv dose in accordance with the seven biologic effects on ionizing radiation report (Griffey et al, 2008). They ended up with a sample size of 100 patients and their conclusion indicated a 1.9% of emergency room patients undergoing CT of neck, chest, abdomen, or pelvis had high cumulative rates of multiple or repeat imaging. Collectively this group may have a heightened risk of developing cancer from cumulative CT radiation exposure (Griffey et al 2008). Although this study showed a partial risk, its validity should be questioned. The authors did not explain where they gathered their dose amounts from, and it sounds like it was an educated guess based on a formula. To get a true dosing you need to know the patient body type, and the scanner setting, and parameters would have to be

determined. The organization where this study took place also received a new CT scanner after the start of the study; this could also have had an effect on the amount of radiation produced for each scan. What this study did was make an attempt to see if the risk of cancer from having repeat CT scans is higher which it did prove.

The scanner that was used in the latter part of the above study was a 64slice CT .These scanners have only been around for approximately five years. Since their inception there have been many new developments on exams performed by CT scanners, CT coronary angiography being one of those exams. The following study looked at the effects of risk associated with these exams. The study took a phantom and simulated the test that would be performed. They used the recent Biological Effects of Ionizing Radiation report to provide the framework for estimating the lifetime risk (Einstein, Henzlova, and Rajagopalan 2007). The results showed the risk is greater for women, younger patients, and for combined aortic, cardiac scans (Einstein et al., 2007). The authors report the findings are due to the effects of radiation on female's organs and younger children to be more sensitive to radiation effects (Einstein et al., 2007). Not only does radiation affect everyone, but it affects people differently, this is something else for the physicians and radiologists to consider in determining appropriateness of exams.

On December 7, 2007, the FDA made a news release on recommendations to address concern of excess radiation exposure during CT perfusion imaging (FDA.Gov 2009). In October the FDA issued an initial safety notification after learning 206 patients had been exposed to radiation at Cedars-Sinai Medical Center in Los Angeles over an eighteen month period (FDA.Gov 2009). Since then the FDA, working with the state and local health authorities, have identified at least 50 additional patients who were exposed to excess radiation of up to eight

times the expected level during their CT perfusion scans. These cases involved more than one manufacture for CT scanners. Some of these patients reported hair loss or skin redness following their scans (FDA.Gov 2009). Unfortunately, the increased utilization of anything increases the risk of accidents or harm being done.

*What types of processes are being put in place to prevent over utilization of CT and MRI?*

In reference to the above findings of the FDA, they issued recommendations on how to prevent future over exposure. They include facility assessment as to whether a patient who underwent CT perfusion scans received excess radiation. Facilities review their radiation dosing protocols for all CT perfusion studies to ensure that the correct dosing is planned for each study. Facilities implement quality control procedures to ensure that dosing protocols are followed every time and the planned amount of radiation is administered. Radiologic technologists check the CT scanner display panel before performing a study to make sure the amount of radiation to be delivered is at the appropriate level for the individual patient. If more than one study is performed on a patient during one imaging session, practitioners should adjust the dose of radiation so it is appropriate for each study (FDA. Gov 2009). This particular recommendation relates to radiation and how to prevent over radiating during a CT scan, they do not address the problem of how to handle over utilization for these studies in the first place. It does show, however, that the government is concerned with the amounts of radiation being received by patients.

The bigger concern relates back to the formal research question “Do radiologists, radiology administrators, and radiology technologists believe there are over utilization of CAT

scan and MRI exams and if so what do they recommend to ameliorate this issue?" The first study examined dated back to 1998 and the authors did mention their concerns in the following statement. With increasing pressure from third party payers to reduce imaging charges in various ways, including capitation, it is important for radiologist to understand utilization patterns to devise strategies for reducing the inappropriate use of imaging techniques (Khorasani, 1998).

The research did not find many articles on what people intend to do about the problem. Almost all articles found recognized the problem and indicated something should be done about it. Statements such as, "understanding the impact of this change in practice on the quality of care would be useful in justifying the increase use of these new technologies and decreasing their inappropriate use should be a priority in efforts that focus on controlling imaging expenditure" (Matin, et al 2004 pg.7) were found in almost every article.

In the Moskowitz et al. study in 1999, they removed all imaging privileges from gastroenterologists, general surgeons, nephrologists, neurosurgeons, oncologists, pediatric surgeons, and physiatrists. Cardiologists were limited to performing chest radiography, echocardiography, and nuclear cardiology and pulmonologists could only perform chest radiography. All images had to be sent to radiologists for reading and the above offices could only capture the technical component of charges. Orthopedic surgeons were permitted to perform conventional orthopedic radiology but were excluded from performing or interpreting CT and MRI exams. Primary care physicians were only able to obtain chest, rib and extremity radiographs and were only allowed to charge for the technical component with the professional interpretation to be done and charged by the radiologists. The results showed a 20% to 25% decrease in the number of radiographic examinations per 1000 enrollees from the previous trend

(Moskowitz, Sunshine, Grossman, Adams, Gelinas, 1999). This was a large study using Cigna enrollees in a specific region. This was an insurance company's attempt to control utilization of these services and keep the control of imaging services within radiology.

The American College of Cardiology reported that it is currently running a pilot study on the use of its appropriate criteria in practices and has committed to reducing inappropriate imaging by 15 % ( Schauer, Otha 2009). The American Association of Physicists in Medicine issued a statement in which they strongly supported appropriate utilization standards and recommended that they be applied for all procedures in which ionizing radiation is produced (Schauer, et al 2009). This shows that others are recognizing over utilization of imaging services, and are starting to make attempts at reducing utilization.

Some seem to think technology might be the answer. A study was done to determine the effects of a computerized radiology order entry and decision support system on the growth of CT and MR procedures over time in a large academic medical center (Sistrom, Dang, Weilburg, Dreyer, Rosenthal, and Thrall 2009). The study reviewed imaging utilization before during and after implementation of a web based radiology order entry and decision support system. The study evaluated volumes from 2000 to 2007. Growth rates were factored into the final outcomes (Sistrom, et al., 2009). In conclusion they found a substantial decrease in growth for outpatient CT volume. The utilization of outpatient MR imaging decreased less impressively (Sistrom et al 2009). This study showed that additional tools available to assist in making a decision could impact the amount of studies that are ordered could be impacted. The concern with this is the cost of implementing such a tool. With technology comes a price tag of not only the price of the equipment, but implementation and maintenance of a system. (Sistrom et al 2009)

Many insurance companies have attempted to control utilization through preauthorization. A study was done to determine the effects of CT and MRI on a pre-authorization program in the emergency department. The study subjects were non admitted ED patients who had either a CT or an MRI during a control or pre-authorization period. The control group consisted of patients who did not require pre authorization (Smulowitz, NGO, Epstein, 2009). Interesting outcomes of the study were a slight increase in the ordering of MRI studies in the pre authorization group. The CT study group was about the same. The authors indicated the results may have been due to increased need for MRI exams for the pre authorization group. It may have also been related to who knew about the study. If the ED physicians knew about the study they may have skewed the data by trying to prove to the insurance companies that they would order CT and MRI exams whether they had to obtain a pre authorization or not.

Another study attempted to evaluate the effects and applicability of the use of the American College of Radiology (ACR) appropriateness criteria by non-radiology physicians in an MRI pre authorization center (Levy, Blachar, Goldstein, Paz, Olsha, Atal, Goldberg, Dayan., 2006). All MRI requests received for an MRI exam were reviewed in a pre-authorization center during a 19 month time frame. This included time before and after introduction of ACR guidelines. ACR appropriateness was divided into three groups including appropriate, indeterminate, and inappropriate (Levy et al., 2006). The findings were an increased rate of performance of appropriate MRI examinations and a decreased rate of inappropriate MRI examinations. ACR appropriateness criteria were applicable to 50% of the MRI requests. Part of the study included training of the referral center staff by radiologists on the ACR guidelines. It appears once people understood the guidelines the word got out to ordering physicians who then

became more aware of the guidelines and tried to follow their guidelines before submitting a request for an exam.

Another study was done in 2008 to identify how many physicians used the ACR guidelines in making their decision to order a radiology exam. They used a survey sent out to 438 physicians with 126 respondents (Bautista et al., 2009). They only asked three questions including: 1). what is your specialty? 2) how many years have you been in practice? if you are a resident please check your level, 3) when deciding what is the best imaging modality for your patient select the top three sources you usually use and rank them accordingly (Bautista et al., 2009). The results were as follows; 64.3 used radiologist consult, 48.4 used a specialty journal, 41 used an up-to-date an online database, 27.8 used Google, 19.8 used Pub Med, 19 used MD Consult, 18.3 used information from recent CME meetings, 16.7 used bookz from pocket medicine, 15.9 used other, 6.3 used Epocrates, and 2.4 used ACR guidelines. Even though ACR guidelines seemed to be a good resource as the study above showed, no one seems to be using them. Either they are not easily obtainable, hard to read or not well known.

Another study done by the Providence Ambulatory Care and Education Center in Oregon, implemented a training program for faculty and residents on where to find and how to use the ACR guidelines. Laminated pocket cards were handed out to faculty and residents that included ACR guidelines summarizing most common clinical entities encountered. The end results of the study showed an 18 percent reduction in utilization from 2001 to 2002. (Rosenbloom, 2004). The common theme with the majority of the studies has shown the importance of not only having the tools to help reduce utilization but also the importance of



having a system in place to train necessary people to use the systems. It appears the biggest impacts took place when people were shown where the tools were and how to use them.

The Med Pac 2005 recommendations include setting standards for imaging providers and interpreters. They feel there is lack of oversight for imaging tests provided in physician's offices, they feel that Congress should direct the secretary to set standards for providers who bill Medicare for performing and interpreting diagnostic imaging studies (Miller. 2005). Currently most modalities with the exception of mammography have no quality control standards set in place by the government.

Along those same lines Med Pac also recommends developing standards for imaging equipment, qualifications of technologists, qualifications and responsibilities of supervising physician, technical quality of the images produced, procedures for ensuring patient safety, and the professional training, experience and education of the physician who interpret the studies (Miller. 2005). Med Pac also recommends using Medicare claims data to measure fee for service physician's resource use and share results with physicians confidentially to educate them on how they compare with their peers (Miller. 2005). Med Pac feels coding edits should be expanded to unbundled diagnostic imaging services and reduce technical component payment for multiple imaging services performed on contiguous body parts (Miller 2005). The last recommendation by Med Pac is strengthen the rules that restrict physician investment in imaging centers to which they refer Medicare and Medicaid patients (Miller. 2005). Even the government has put recommendations into place to help control over utilization. Interestingly not a single article was found on what hospital administrators, radiologists or technologists are doing to help ameliorate the problem.

*Importance of this study.*

Multiple articles discussed within this literature review show there is over utilization of imaging studies in particular CT and MRI. These utilization increases have taken place in different types of facilities who have studied the growth rates over the past several decades. It has also taken place within the Medicare and Medicaid populations. Most of the studies quote the need for all involved to start recognizing the problem, and the need for change to occur.

The financial implications and comparison to Japans imaging was pointed out to show the cost of exams in the United States is high in relation to Japan and other countries. The reviews of many papers quoted that imaging cost have an impact on rising health care costs. The government has raised concerns over the increasing costs and has started providing recommendations on how they can help the issue. Radiation exposure in CT, one of the two modalities of concern has increased exposure to individuals. Studies have shown people being exposed too frequently, and also shows ordering physicians and radiologists not knowing how much radiation the patient is being exposed to.

Several large organizations have put guidelines in place to help ameliorate the problem. The most complete seems to be the ACR guidelines, but studies have also shown not many physicians or radiologists are using them. Med Pac has issued some recommendations on what they feel the government should do to help the problem, yet nothing concrete has been put in place. The most successful studies showed education of those who order the exams to be successful measures, whether it is through a computerized tool or a formal training session.

The intent of this particular study is, to see if Radiologists, Administrators, and technologist agree there is a problem with CT and MRI over utilization. Another goal is to see if Radiologists, administrators and technologists are doing anything about this issue.

## Chapter 3. Methodology

### *Method or Approach to the Problem*

The methods and design of this study was conducted to answer the formal research question: Do radiologists, radiology administrators, and radiology technologists believe there is over utilization of CAT Scan and MRI exams and if so what do they recommend to ameliorate the issue? After analyzing several methods, it was determined the most appropriate way to understand what individuals' thoughts are and what they are doing was to reach out the above groups using a descriptive survey. The survey method seemed most appropriate because it allows data to be collected based on individual opinions. The survey method to be used also allows the respondents to describe what they are doing or what they intend to do to help resolve the problem.

This study was approved by the Regis University institutional review board before surveys were distributed. A survey using the Website [www.surveymonkey.com](http://www.surveymonkey.com) was created to investigate the opinions of radiologists, radiology administrator, CAT Scan and MRI technologists on the utilization of CT and MRI, and to find what their organizations have put into place to help resolve the problem.

### *Research Design*

Please see appendix A for a full view of the survey. The questions have several components; the first two were general demographic questions. The first asking for the title of the individual filling out the survey, in order to help determine who's opinions of the three groups are most prevalent. The second question asked the respondents what type of organization

they worked in. This question was asked to again help identify what type of organizations respondents were most prevalent.

Questions three through six asked more specific demographics in relation to CAT Scan and MRI. Question three asked and five asked “How many exams does your organization do each year question three related to CAT Scan and question five related to MRI. These questions were developed to help asses’ averages, high and low number of CAT Scans and MRI performed in organizations. Question number four for CAT Scan and six for MRI asked ‘Have volumes increased in your organization over the past five years?’. The reason this question was asked was to determine if these medical facilities are experiencing increased utilization in these modalities. Questions three through six only allowed one answer per question to prevent inaccurate data.

Questions seven and eight related to the respondents individual opinions on utilization of these two modalities both in the United States and in their individual organizations. These questions were asked because they related directly to the research question, to help identify the opinions of the three groups. The reason for both questions being asked is because some may see over utilization as a problem as a whole but not see utilization as a problem in their organization, which would help identify if this particular group may have a best practice in place to reduce utilization.

Questions nine through eleven were asked to help identify what is known and what is being done. The intent of these questions were to help understand if more education is needed on the programs that are available or to identify if other programs are being developed other than

those that were identified in the literature review to include ACR guidelines, FDA recommendations to prevent over exposure, or Med Pac recommendations.

Question twelve asks why they put a system into place. The development of this question related back to some much of the problem areas identified in the literature review. Question thirteen also related to a big area of concern in the literature review around radiation exposure in CT. It specifically asked if the respondents are concerned with radiation exposure in CT. Questions one through thirteen were designed to help answered the formal research question or were related to finding further information identified in the literature revise. Question fourteen was developed to allow the respondents access to the results of the survey.

### *Sampling Strategy*

After IRB approval and adjustments were made, several professional organizations were contacted for distribution. The organizations that were contacted were the American Society of Radiologic Technologists (ASRT) and American Registry of Radiologic Technologists (ARRT) 37,000 CT technologist and 25,000 MRI technologists. The American Healthcare Radiology Administration (AHRA) currently has 4,000 members mostly radiology administrators. The Radiologic Society of North America (RSNA) consisting of approximately 40,000 members mostly Radiologists. The organizations were contacted, the ASRT and the ARRT were only able to provide mailing list for a fee. Since the survey was developed to be sent and collected electronically these two groups were eliminated. The RSNA will not give lists to any third party eliminating potential of using this group. The AHRA agreed to help distribute to their e-mail list of 9,000 current and past members changing the population to mostly radiology administrators, managers and directors. The following message from the AHRA was sent with a link to the

survey to include the consent form (see appendix B), “ On behalf of one of our members, AHRA is distributing a short 13 question survey on CT and MRI utilization which is being conducted in order to help establish best practices. Results will be available to anyone who participates and may also be published in a future AHRA publication. To read more about the full scope of the survey, as well as take the survey please click on the link below. Please also kindly forward to your radiologists and CT/MRI technologists.” The survey remained open for 17 days with a reminder on day 4, another on day 8, and one more on day 12.

Survey was closed and data was exported from Survey Monkey to excel spreadsheets where it was analyzed and put into graphs

#### *Method of Analysis*

On day 17 the survey was closed and the data was exported from Survey Monkey to an excel spreadsheet where it was aggregated into descriptive statistics and graph form by question. Descriptive statistics and graphs were used in order to condense the data into a format that allows the data to be easily understood by the readers. Graphs were formulated in frequency distribution tables to show where the majority of the answers for each question fell. Central tendency counts were used for questions three and five to again display where the majority of the respondent's answers fell. Nominal measurements were used for the rest of the questions to display where the majority of the answers fell for those questions.

## Chapter 4. Data Collection and Analysis

The data was collected from 380 respondents to the 13 question survey sent to 9,000 individuals through the AHRA. The following represents descriptors and graphs represent the data gathered for each question.

**Table 1**  
**Question # 1: What is your title?**

What is your title?		
Answer Options	Response Percent	Response Count
Radiology Administrator	21.4%	73
Radiology Director	35.2%	120
Radiology Manager	24.9%	85
MRI or CT Technologist	16.1%	55
Radiologist	2.3%	8
Other (please specify)		46
<i>answered question</i>		<b>341</b>
<i>skipped question</i>		<b>39</b>

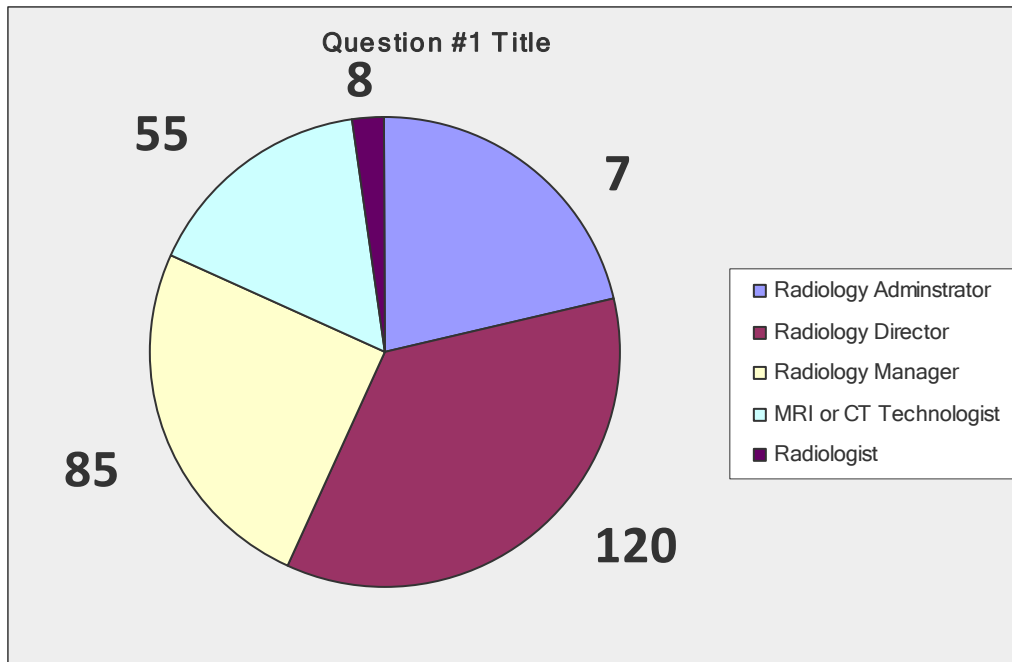
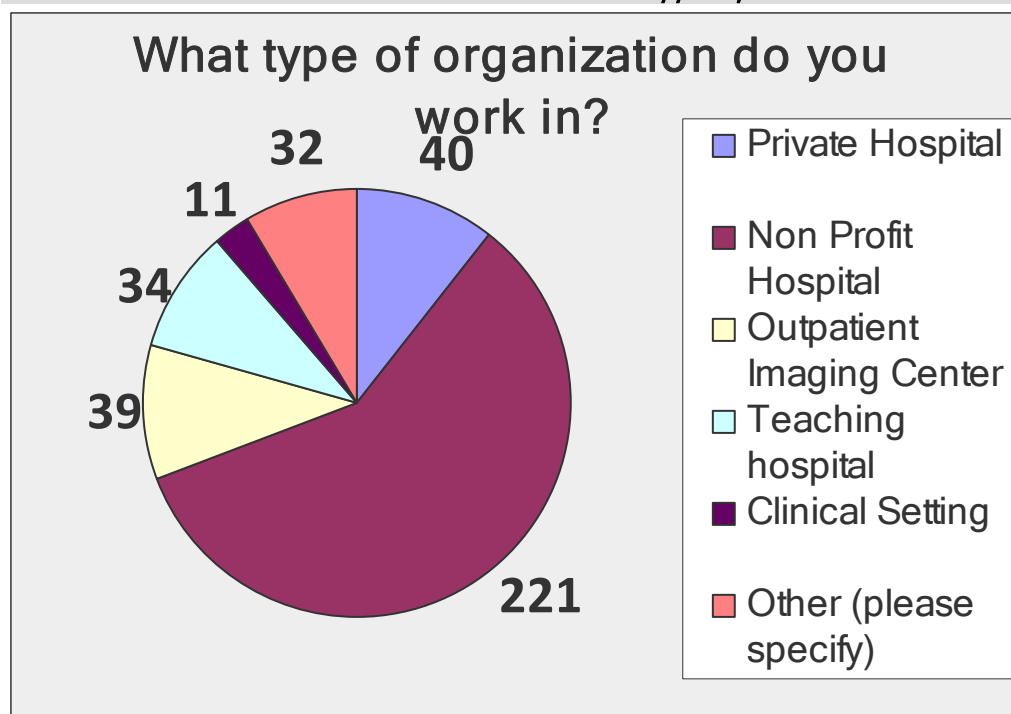




Table 2

Question # 2: What type of organization do you work in?

What type of organization do you work in?		
Answer Options	Response Percent	Response Count
Private Hospital	10.6%	40
Non Profit Hospital	58.6%	221
Outpatient Imaging Center	10.3%	39
Teaching hospital	9.0%	34
Clinical Setting	2.9%	11
Other (please specify)	8.5%	32
<i>answered question</i>		<b>377</b>
<i>skipped question</i>		<b>3</b>

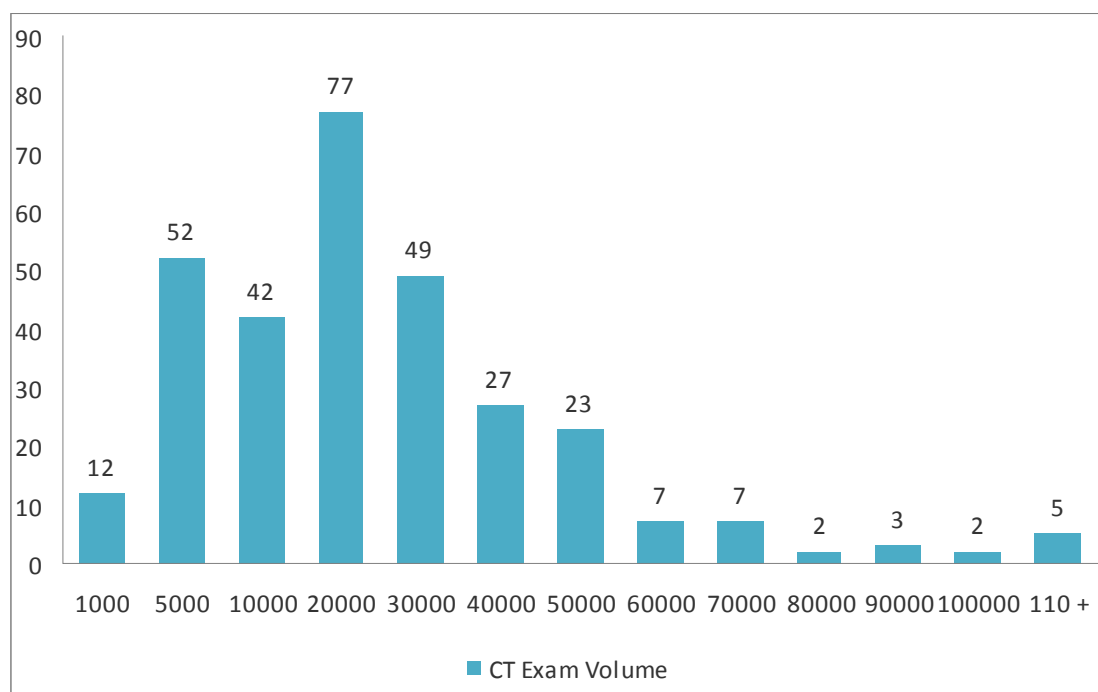


**Table 3**

**Question # 3: What is your facilities annual CT procedure volume?**

What is your facility's annual CT procedure volume (inpatient/outpatient/emergency)?	
Answer Options	Response Count
	341
<i>answered question</i>	<b>341</b>
<i>skipped question</i>	<b>39</b>

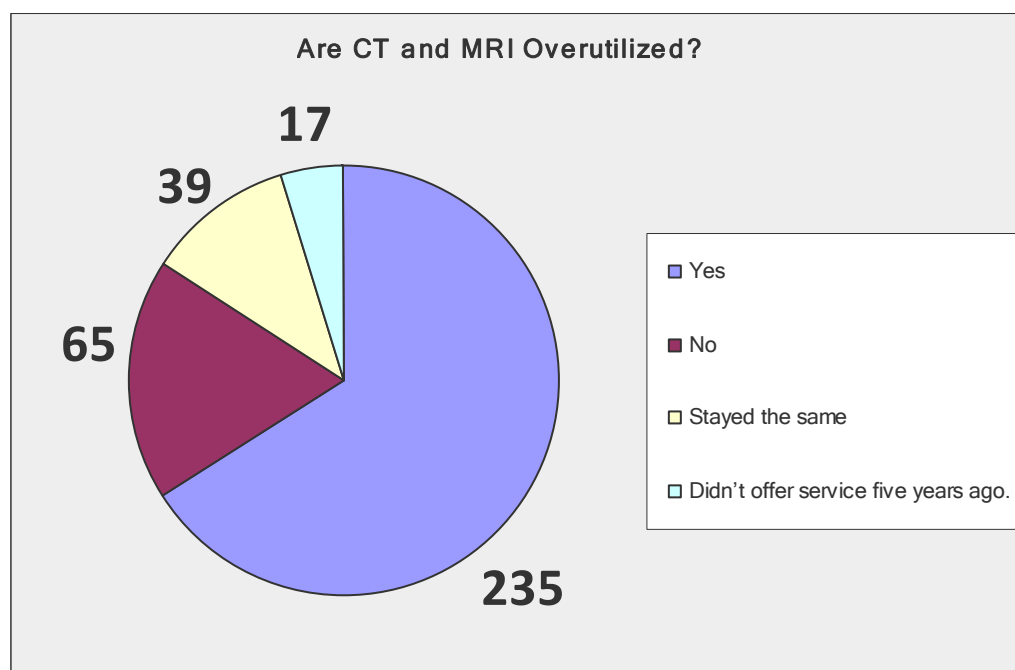
NA, No Services, or don't know	24
Mean	23789
Median	16000
High	400000
Low	300



**Table 4**

**Question # 4: Have CT volumes in your organization increase over the past five years?**

Have CT volumes in your organization increased over the past five years?		
Answer Options	Response Percent	Response Count
Yes	66.0%	235
No	18.3%	65
Stayed the same	11.0%	39
Didn't offer service five years ago.	4.8%	17

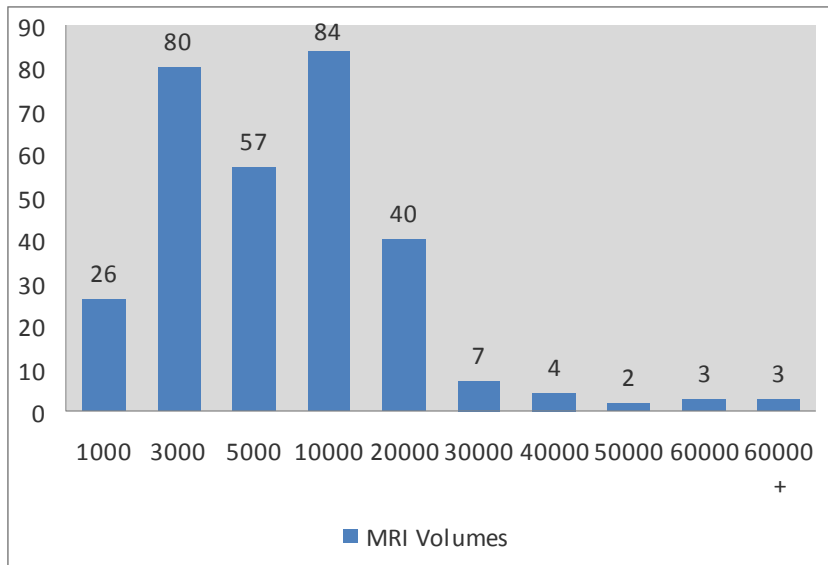


**Table 5**

**Question # 5: What is your facilities annual MRI procedure volume?**

What is your facility's annual MRI procedure volume (inpatient/outpatient/emergency)?	
Answer Options	Response Count
	335
<i>answered question</i>	<b>335</b>
<i>skipped question</i>	<b>45</b>

NA or No MRI services	23
Mean	8589
Median	5000
High	174000
Low	250



**Table 6**

**Question #6 Have MRI volumes in your organization increased over the past five years?**

Have MRI volumes in your organization increased over the past five years?		
Answer Options	Response Percent	Response Count
Yes	62.0%	219
No	19.8%	70
Stayed the same	12.2%	43
Didn't offer service five years ago.	5.9%	21
<i>answered question</i>		<b>353</b>
<i>skipped question</i>		<b>27</b>

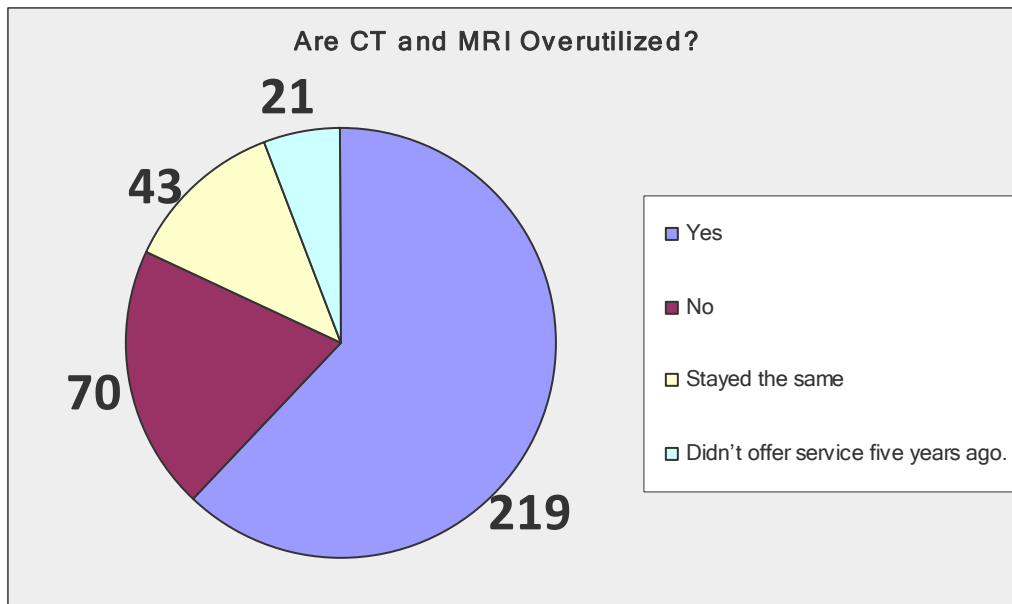


Table 7

**Question # 7: Do you feel CT and MRI are over utilized in the United States?**

Do you feel CT and MRI are over utilized in the United States?		
Answer Options	Response Percent	Response Count
Yes	62.1%	228
No	13.1%	48
Only CT	24.0%	88
Only MRI	0.8%	3
<i>answered question</i>		<b>367</b>
<i>skipped question</i>		<b>13</b>

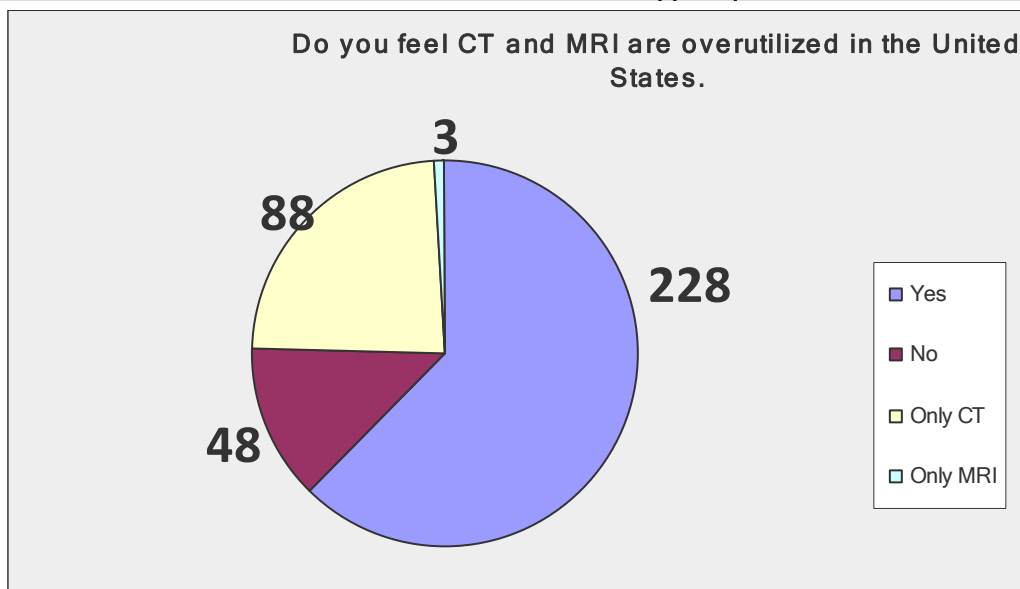


Table 8

**Question #8: Do you feel CT are over utilized in your organization?**

Do you feel CT and MRI are over utilized in your organization?		
Answer Options	Response Percent	Response Count
Yes	45.7%	169
No	29.5%	109
Only CT	22.7%	84
Only MRI	2.2%	8
<i>answered question</i>		<b>370</b>
<i>skipped question</i>		<b>10</b>

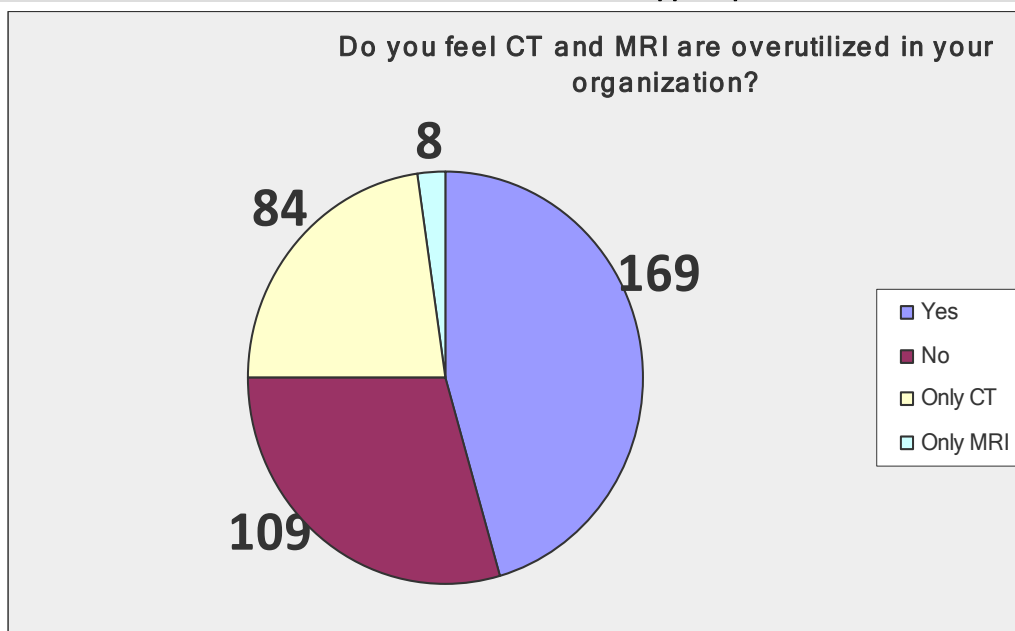


Table 9

**Question #9: Does your organization have any programs in place to mitigate overutilization?**

Does your organization have any programs in place to mitigate over utilization?		
Answer Options	Response Percent	Response Count
Yes	41.2%	141
No	58.8%	201
Planned efforts (please explain)		127
<i>answered question</i>		<b>342</b>
<i>skipped question</i>		<b>38</b>





Table 10

**Question # 10: Are you aware of any of the following tools?**

Are you aware of any of the following tools? Please check all you are aware of.		
Answer Options	Response Percent	Response Count
ACR Appropriateness Criteria	83.6%	310
FDA Initiative to Reduce Unnecessary Radiation Exposure From Medical Imaging	72.0%	267
Med PAC recommendations on setting standards for imaging services	22.9%	85
Not aware of any of these programs	11.6%	43
<i>answered question</i>		<b>371</b>
<i>skipped question</i>		<b>9</b>

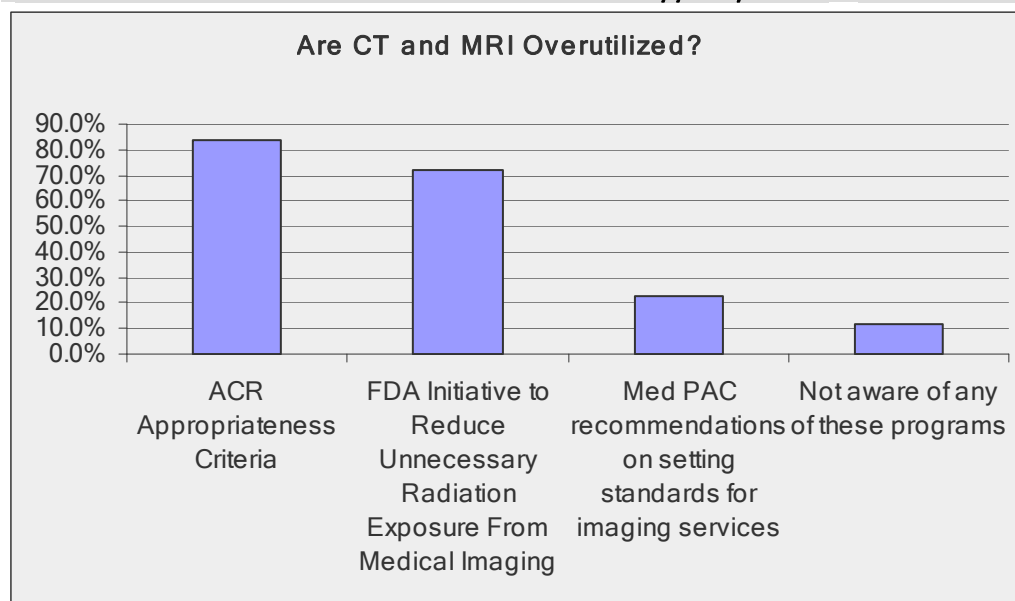


Table 11

**Question 11: What have you put in place or what do you plan on putting in place to mitigate over utilization?**

What have you put in place or what do you plan on putting in place to mitigate over utilization? Please check all that apply.		
Answer Options	Response Percent	Response Count
ACR Appropriateness Criteria	49.4%	177
FDA Initiative to Reduce Unnecessary Radiation Exposure From Medical Imaging	29.3%	105
Med PAC recommendations on setting standards for imaging services	6.4%	23
Decision support software	17.3%	62
Nothing	32.7%	117
Have developed own system, or use another system	15.9%	57
Please explain		74
<b>answered question</b>		<b>358</b>
<b>skipped question</b>		<b>22</b>

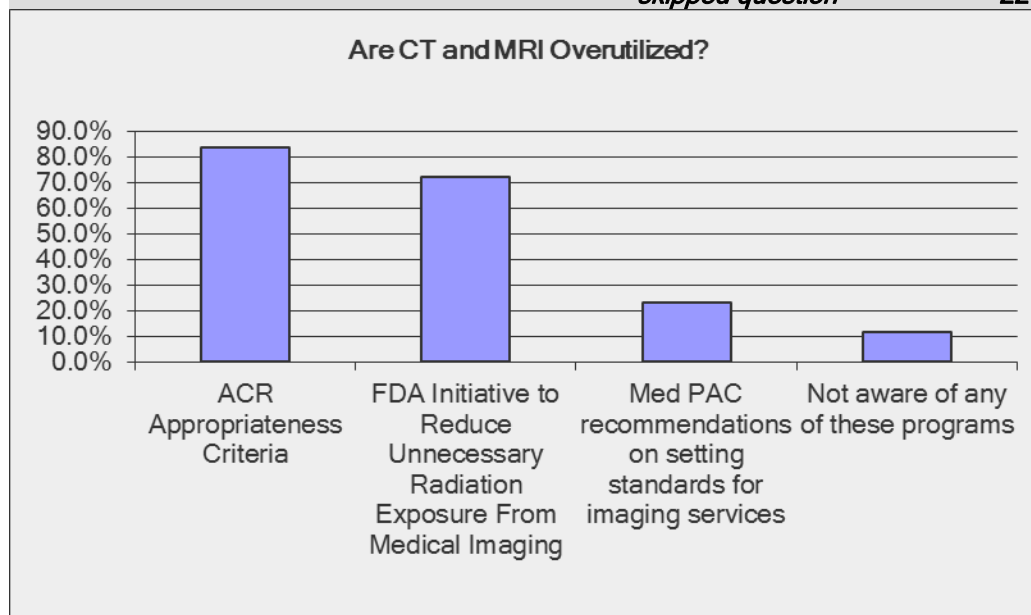
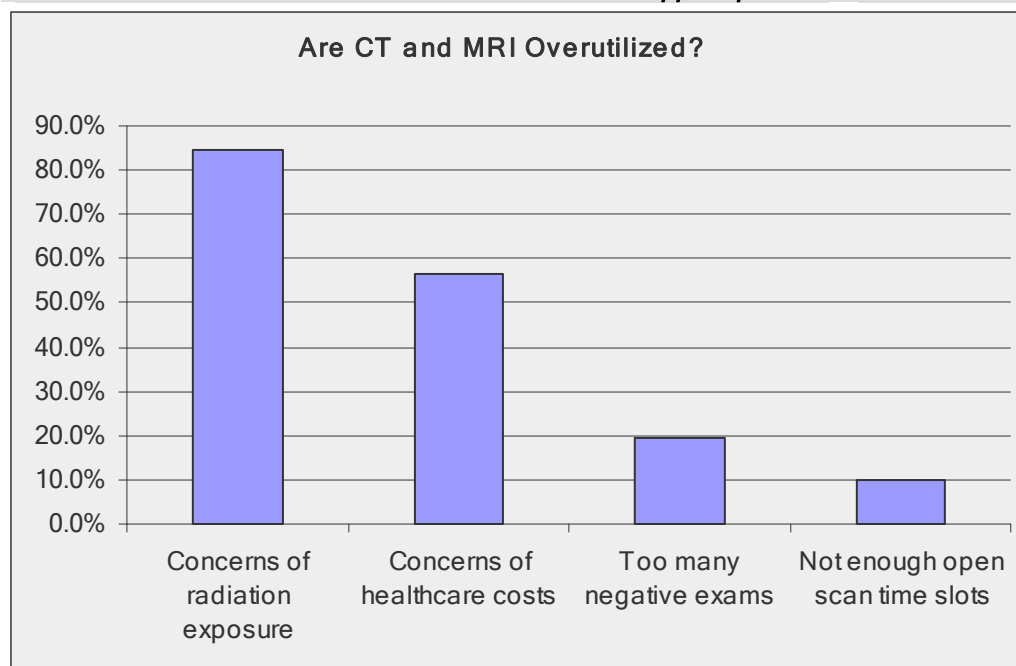


Table 12

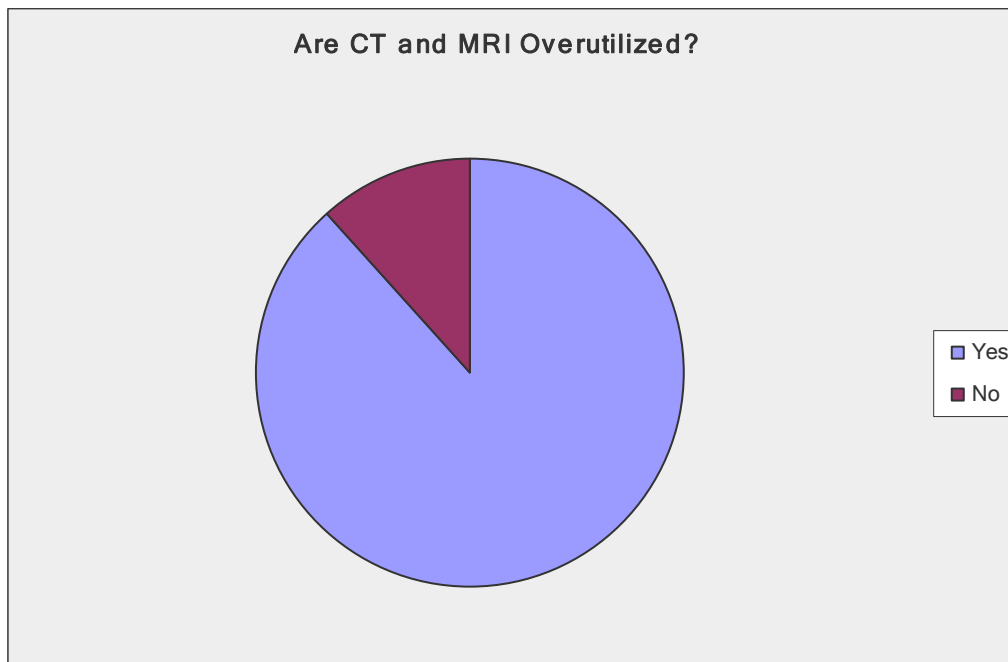
**Question 12: Why did you put a system into place?**

Why did you put a system in place? Please check all that apply.		
Answer Options	Response Percent	Response Count
Concerns of radiation exposure	84.4%	211
Concerns of healthcare costs	56.4%	141
Too many negative exams	19.6%	49
Not enough open scan time slots	10.0%	25
Other (please specify)		42
<i>answered question</i>		<b>250</b>
<i>skipped question</i>		<b>130</b>



**Table 13****Question 13: Are you concerned about levels of radiation exposure with increased CT usage?**

Are you concerned about levels of radiation exposure with increased CT usage?		
Answer Options	Response Percent	Response Count
Yes	88.3%	326
No	11.7%	43
<i>answered question</i>		<b>369</b>
<i>skipped question</i>		<b>11</b>



**Table 14**

**Question 14: If you would like a copy of the results please add your e-mail address in the box below.**

If you would like a copy of the results please add your e-mail address in the box below.	
Answer Options	Response Count
	261
<i>answered question</i>	261
<i>skipped question</i>	119

## Chapter 5. Results, Conclusions, and Recommendations

### *Utilization themes*

The results from the survey coincided with much of the literature review. CAT Scan and MRI volumes continue to climb, sixty six percent of the respondents said CAT Scan volumes have increased in the past five years. Sixty two percent of respondents said MRI volumes have continued to climb in the past five years. These findings were similar to the studies by Matin et al, and the study by Khorsanin et al on pages 16 of this literature review. Eighty eight percent of respondents indicated they were concerned with radiation from CAT Scans. It's apparent from literature review and this survey that the concern for CAT Scan radiation exists as indicated in the literature review by Brenner on page 28, Griffer et al on pg 29 and the FDA on page 30, and by question 13 in this survey. . While volumes continue to rise, sixty two percent of the respondents feel CAT Scan and MRI are overutilized in the United States while only forty seven percent felt that it was an issue in their organization. Only forty one percent said they have something in place to help mitigate. Again the awareness seems apparent yet not everyone is reacting to it.

Three hundred and ten out of three hundred seventy one respondents are aware of ACR appropriateness criteria. Two hundred and sixty seven are also aware of FDA recommendations. Yet only one hundred forty one have a program in place to mitigate overutilization. This again indicates a strong awareness of programs that are out there but less than half of respondents have something in place.

### *Conclusions relating back to formal research question*

The formal research question "Do Radiologists, radiology administrators, and radiology technologists believe there is over utilization of CAT Scan and MRI exams and if so what do

they recommend to ameliorate the issue?” was answered through the eyes of the radiology administrator with little feedback from the other two groups. With that being said sixty two percent said they felt CAT Scan and MRI are over utilized in the United States. The recommendations to ameliorate the issues stem from best practices that have been put into place, forty nine percent are using ACR appropriateness criteria, and twenty nine percent are using FDA recommendations while thirty three percent are doing nothing at this time. However no one strong recommendation came out of this study.

#### *Conclusions on best practices and what is being done*

Of those who do have something in place the ACR guidelines are most prevalent, this may be due to more organizations becoming accredited by the ACR forcing them to put some of the ACR policies and practices into place. FDA recommendations were also commonly used. Some of the more common free text answers included having radiologists more involved in consultation for appropriate exam to be performed, other types of organizational guidelines on ordering, and decision support software. Again thirty three percent said they have nothing in place.

#### *Conclusions on why programs were put into place*

Eighty four percent of those who have a program in place did so because of concerns of radiation in CAT Scan. Fifty six percent did so because of their concerns with healthcare costs. Radiation exposure and healthcare costs were prevalent in previous studies as well.

#### *Recommendations*

It appears that the recognition of over utilization exists. However many still have not put a program into place to help with mitigation. The original intent was to get a good sample from the three groups mentioned; radiologists, radiology administrators, CAT Scan and MRI

technologists. Due to constraints on a means to reach radiologists and CAT Scan and MRI technologists the survey population was heavily weighted with the opinions of the radiology administrators. Suggestions for additional research would be as follows; a survey to the other two groups as well as a survey to physicians who frequently use these imaging modalities would be helpful in determining the reasons for the increases in utilization. From the literature review the Emergency Room physicians seem to be the biggest users of these two modalities. Targeting this group may be a good place to start with understanding ordering practices. It would also be useful to send this survey out in another 5 years to the same group to see if practices have changed.

#### *Discussion and contributions to health care administration*

This study's original intent was to see if there was a perceived problem with overutilization of CAT Scan and MRI imaging modalities. Through the survey it was determined the general perception is in the United States there is overutilization, yet not all recognizes it as an issue in their own organization. The other main intent was to see if there is a best practice in place to help mitigate the problem. Those who do have programs in place are using the ACR guidelines. Many of the respondents saw radiation and health care costs as a concern to the problem. Yet many are doing nothing to help resolve the problem. Hopefully this study will help others understand the complexity of this issue, see that there are some practices in place to help with the problem, guide health care administrators down the path of resolving over utilization of CAT Scan and MRI procedures. As technology continues to advance and new ways are found to practice medicine health care administrators are going to continue to face similar issues. Hopefully the understanding of the problems and the basis for this research will help guide



others to formulate the problems and find answers to best practices and how to use the technology while keeping the patients best interest in mind.

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## Appendix A

## Are CT and MRI Over utilized?

[Exit this survey](#)

2.

Please fill out all questions, some have the ability to give multiple answers.

### 1. What is your title?

- What is your title? Radiology Administrator
- Radiology Director
- Radiology Manager
- MRI or CT Technologist
- Radiologist

Other (please specify)

### 2. What type of organization do you work in?

- What type of organization do you work in? Private Hospital
- Non Profit Hospital
- Outpatient Imaging Center
- Teaching hospital
- Clinical Setting
- Other (please specify)

### 3. What is your facility's annual CT procedure volume (inpatient/outpatient/emergency)?

What is your facility's annual CT procedure volume (inpatient/outpatient/emergency)?

### 4. Have CT volumes in your organization increased over the past five years?

- Have CT volumes in your organization increased over the past five years?  
Yes
- No
- Stayed the same
- Didn't offer service five years ago.

**5. What is your facility's annual MRI procedure volume (inpatient/outpatient/emergency)?**

What is your facility's annual MRI procedure volume (inpatient/outpatient/emergency)?

**6. Have MRI volumes in your organization increased over the past five years?**

- Have MRI volumes in your organization increased over the past five years? Yes
- No
- Stayed the same
- Didn't offer service five years ago.

**7. Do you feel CT and MRI are over utilized in the United States?**

- Do you feel CT and MRI are over utilized in the United States? Yes
- No
- Only CT
- Only MRI

**8. Do you feel CT and MRI are over utilized in your organization?**

- Do you feel CT and MRI are over utilized in your organization? Yes
- No
- Only CT
- Only MRI

**9. Does your organization have any programs in place to mitigate overutilization?**

- Does your organization have any programs in place to mitigate overutilization? Yes
- No

Planned efforts (please explain)

**10. Are you aware of any of the following tools? Please check all you are aware of.**

- Are you aware of any of the following tools? Please check all you are aware of. ACR Appropriateness Criteria
- FDA Initiative to Reduce Unnecessary Radiation Exposure From Medical Imaging
- Med PAC recommendations on setting standards for imaging services
- Not aware of any of these programs

**11. What have you put in place or what do you plan on putting in place to mitigate overutilization? Please check all that apply.**

- What have you put in place or what do you plan on putting in place to mitigate overutilization? Please check all that apply. ACR Appropriateness Criteria
- FDA Initiative to Reduce Unnecessary Radiation Exposure From Medical Imaging
- Med PAC recommendations on setting standards for imaging services
- Decision support software
- Nothing
- Have developed own system, or use another system

Please explain

**12. Why did you put a system in place? Please check all that apply.**

- Why did you put a system in place? Please check all that apply. Concerns of radiation exposure
- Concerns of healthcare costs
- Too many negative exams
- Not enough open scan time slots

Other (please specify)

**13. Are you concerned about levels of radiation exposure with increased CT usage?**

- Are you concerned about levels of radiation exposure with increased CT usage? Yes
- No

**14. If you would like a copy of the results please add your e-mail address in the box below.**

If you would like a copy of the results please add your e-mail address in the box below.

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## Appendix B

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Dear Respondent:

I am a graduate student at Regis University's Rueckert-Hartman College for Health Professionals and, with AHRA's help; I am inviting you to participate in a research project to address the following issue: Do radiologists, radiology administrators, and radiology technologists believe there is overutilization of CT and MRI exams and, if so, what do they recommend to ameliorate the issue? The questionnaire should only take about 10 minutes to complete.

The results of this project will be used to identify if there is a perception of overutilization of these services. It will also help identify best practices for those who feel there is a problem. The results and full study will be available to anyone who participates.

Other than your title, type of organization you work in, and how many exams your organization does, no identifying information will be asked. Your answers will be pooled with other participants so your responses cannot be traced back to you or the organization you work for. Information gathered from this study may be published in professional journals or presented at professional meetings. Your identity or your organization's identity will not be revealed in any such publications or presentations. The institutional review board (IRB) at Regis University has approved this study. Consent to participate will be assumed with the completion of the study.

If you have any questions, you may contact the IRB at Regis University, office of Academic Grants, 447 Main, Mail Code H-4, 333 Regis Boulevard, by phone at (303) 346-4206, or by e-mail at [emay@regis.edu](mailto:emay@regis.edu).

Sincerely,

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