Impact of Image Gently Campaign at a Medium-Sized Teaching Hospital

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Introduction

More than 62 million CT scans are performed each year in the United States, compared with 3 million in 1980. Approximately 4 million scans per year are performed on children.[1] Recent literature suggests that approximately 2% of future cancers may be directly attributable to CT scanning in children. One study estimated that 4,350 future cancers could be induced by 1 year of pediatric CT imaging in the United States.[2] Young patients are at higher risk for developing cancer because they are more radiosensitive and have longer post-radiation life spans. The Society for Pediatric Radiology implemented the Image Gently Campaign on January 22, 2008 to raise awareness about methods to reduce radiation dose.[3] Examples of methods to reduce radiation dose to children include utilizing non-ionizing imaging exams whenever possible, using child optimized techniques, such as collimation and avoiding the use of grids.[4]

We sought to determine how the Image Gently Campaign has affected the imaging of pediatric patients at Loma Linda University Medical Center. Specifically, we wanted to determine if the number of ionizing examinations at Loma Linda University Medical Center significantly decreased in pediatric patients since the implementation of the Image Gently Campaign in 2008. We also wanted to determine if there has been a significant shift from the use of CT as the initial imaging examination in pediatric patients presenting to the emergency department with suspected appendicitis since the Image Gently Campaign in 2008.

Methods

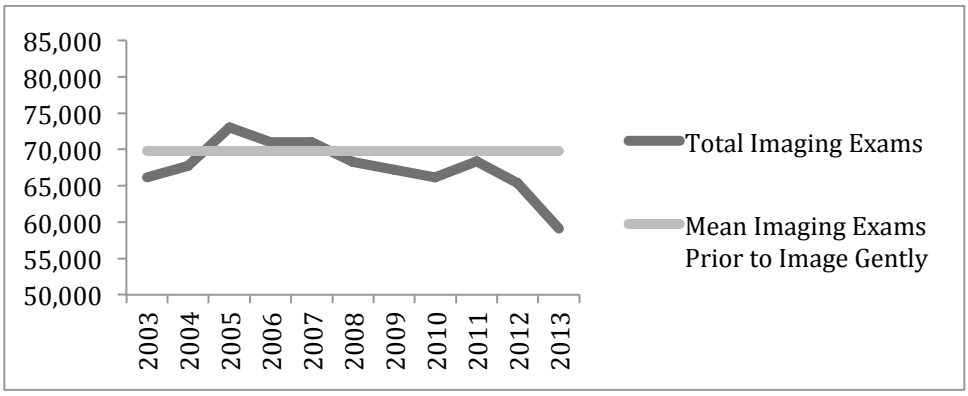
To investigate whether the use of ionizing radiologic examinations at Loma Linda University Medical Center has decreased since the implementation of the Image Gently Campaign in 2008, a retrospective search was performed on the Loma Linda University Medical Center picture archiving and communication system from 2003 to 2013. The number of CT, radiograph, ultrasound, MRI and total number of imaging examinations performed in pediatric patients, defined as 18 years of age and under, were determined for each year between 2003 and 2013. The number of CT abdomen and pelvis examinations for pediatric patients between 2003 and 2013 was also determined. The data is illustrated as line graphs and pie charts.

In order to investigate whether there has been a significant change from using CT as the initial imaging examination in pediatric patients presenting to the emergency department with suspected appendicitis at Loma Linda University Medical Center, a retrospective search was performed on the Loma Linda University Medical Center picture archiving and communication system and the imaging algorithm was investigated for cases that had a reason for study that suggested the

clinician was concerned about possible appendicitis. This was done for 2007, which was the year prior to the Image Gently Campaign, 2008, which was the year of the Image Gently Campaign, and 2013, which was the most recent year. For these cases, the imaging algorithm was investigated by determining whether the patient received an ultrasound examination or CT examination first, and what imaging examinations were ordered in total for the patient's workup. The data is illustrated as pie charts.

Results

The overall number of non-ionizing imaging examinations has increased while the overall number of ionizing imaging examinations have decreased between 2003 and 2013. The overall total imaging examination peak was in 2005 with a total of 73,010 examinations performed. The mean total number of exams prior to the Image Gently Campaign was 69,796. The mean total number of non-ionizing exams prior to the Image Gently Campaign was 9,987. The mean total number of ionizing exams prior to the Image Gently Campaign was 59,809. Comparing the data from 2013 with the mean prior to the Image Gently Campaign, there was a 12% decrease in the total number of imaging examinations, a 16% increase in the number of non-ionizing imaging examinations and a 21% decrease in the number of ionizing imaging examinations (**Figure 1)**.



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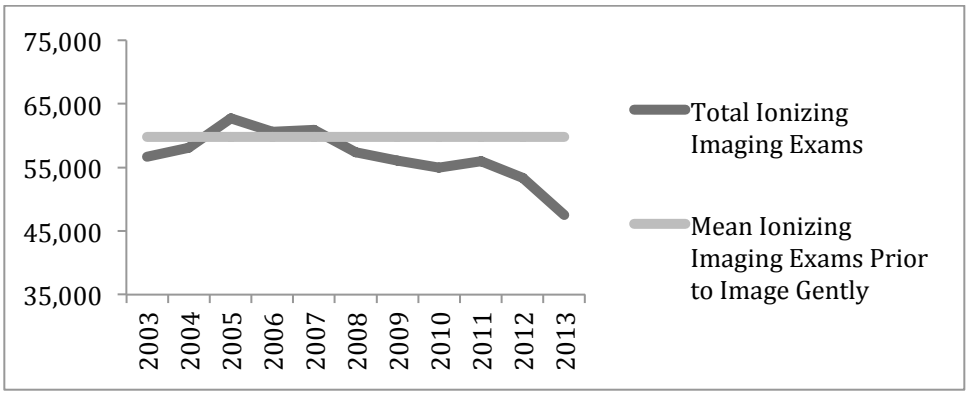

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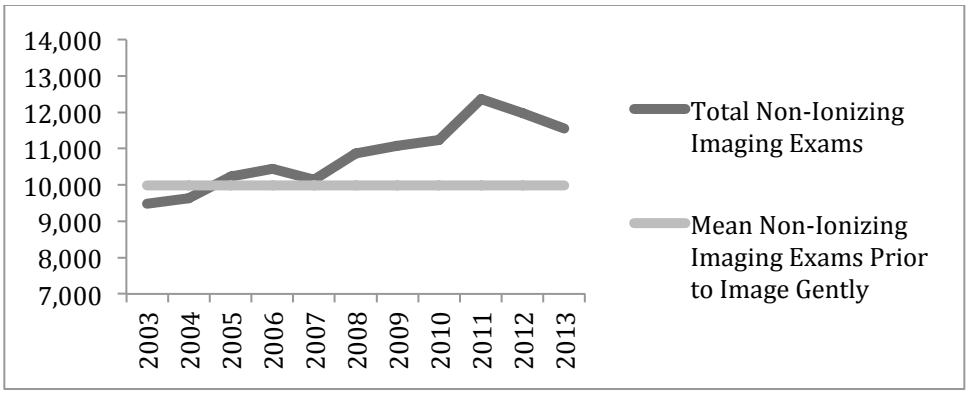

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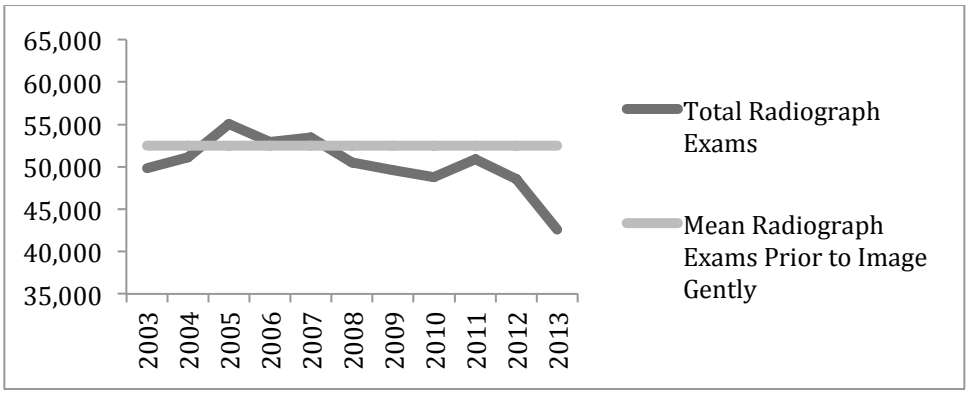
Figure 1: Data from Loma Linda University Medical Center from 2003 to 2013. **(a)** Line graph representation of overall total imaging examinations with baseline mean number of examinations prior to Image Gently. **(b)** Line graph representation of total ionizing imaging examinations with baseline mean number of examinations prior to Image Gently. **(c)** Line graph representation of total non-ionizing imaging examinations with baseline mean number of examinations prior to Image Gently.

The total number of imaging examinations have decreased largely due to a decrease in CT and radiograph examinations while there has been an increase in the number of MRI and ultrasound examinations (**Figure 2**). The mean total number of radiograph exams prior to the Image Gently Campaign was 52,492. The mean total number of CT exams prior to the Image Gently Campaign was 7,317. The mean total number of MRI exams prior to the Image Gently Campaign was 3,892. The mean total number of ultrasound exams prior to the Image Gently Campaign was 6,095. When comparing the mean prior to the Image Gently Campaign to the data from 2013, there has been a 33% decrease in the number of CT examinations, a 19% decrease in the number of radiograph examinations, a 13% increase in the number of ultrasound examinations, and a 19% increase in the number of MRI examinations (**Figure 3**). The mean total number of CT abdomen and pelvis exams prior to the Image Gently Campaign was 2,247. For CT abdomen and pelvis examinations, there was a 64% decrease in 2013 from the mean prior to the Image Gently Campaign (**Figure 4**).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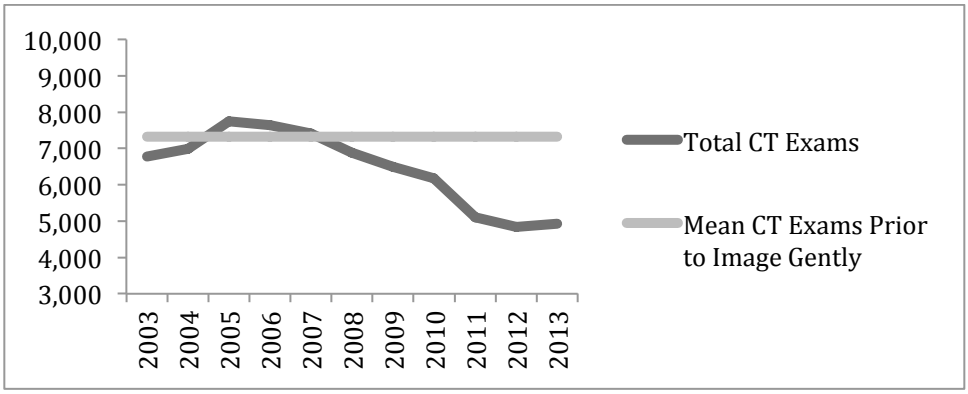
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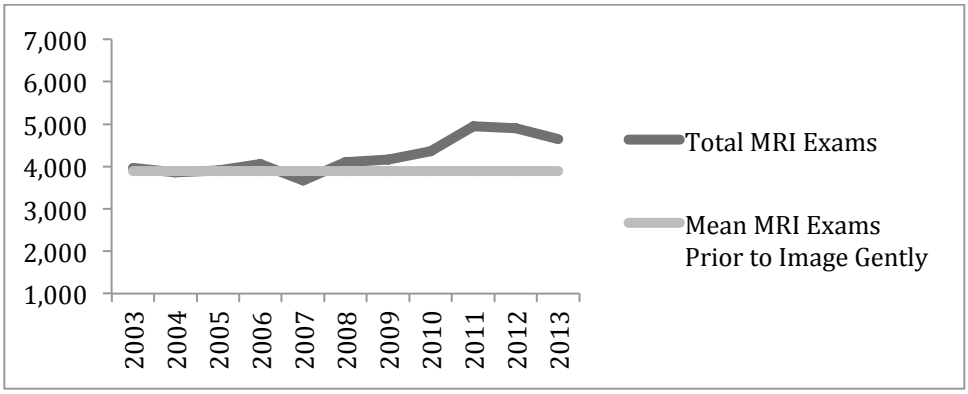
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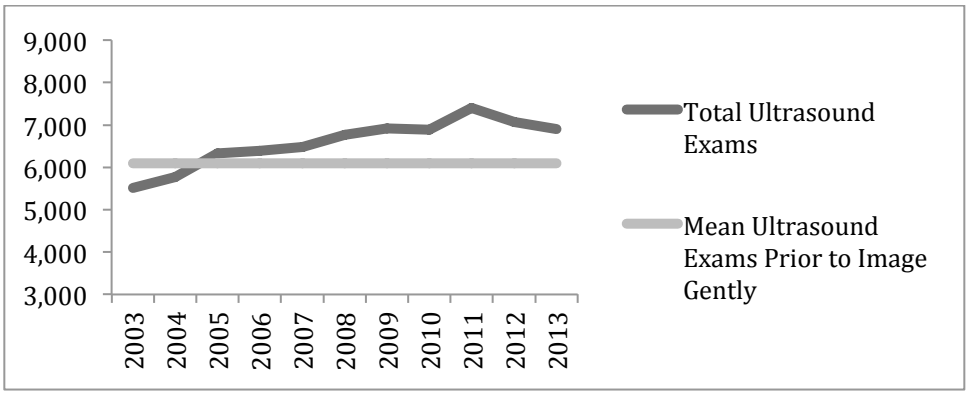
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Figure 2: Data from Loma Linda University Medical Center from 2003 to 2013. **(a)** Line graph representation of total radiograph examinations with baseline mean number of radiograph examinations prior to Image Gently. **(b)** Line graph representation of total CT examinations with baseline mean number of CT examinations prior to Image Gently. **(c)** Line graph representation of total MRI examinations with baseline mean number of MRI examinations prior to Image Gently. **(d)** Line graph representation of total ultrasound examinations with baseline mean number of ultrasound examinations prior to Image Gently.

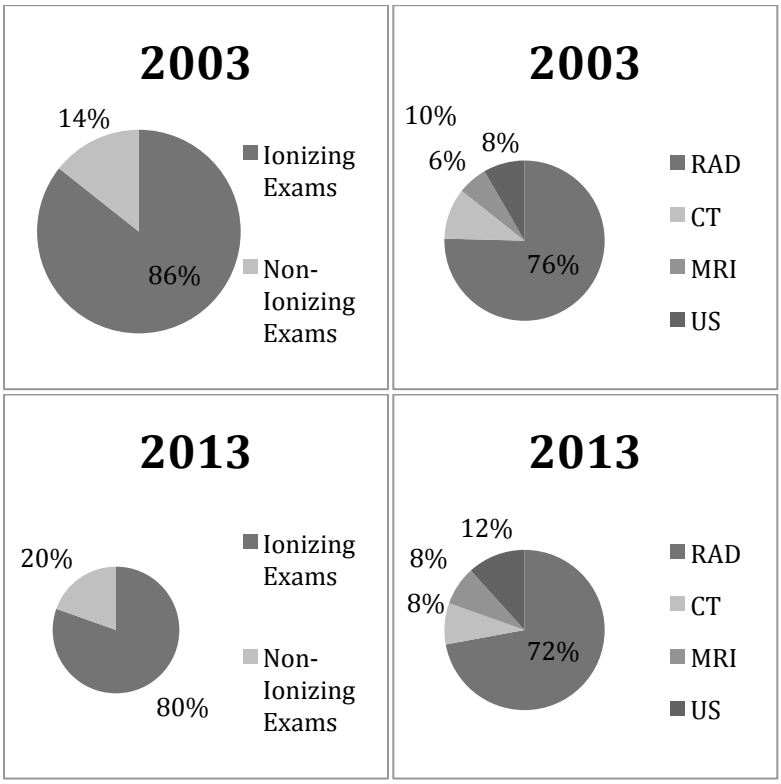

Figure 3: Pie chart representation of overall proportion of ionizing (radiograph and CT) and non-ionizing (ultrasound and MRI) examinations at Loma Linda University Medical Center comparing 2003 with 2013.

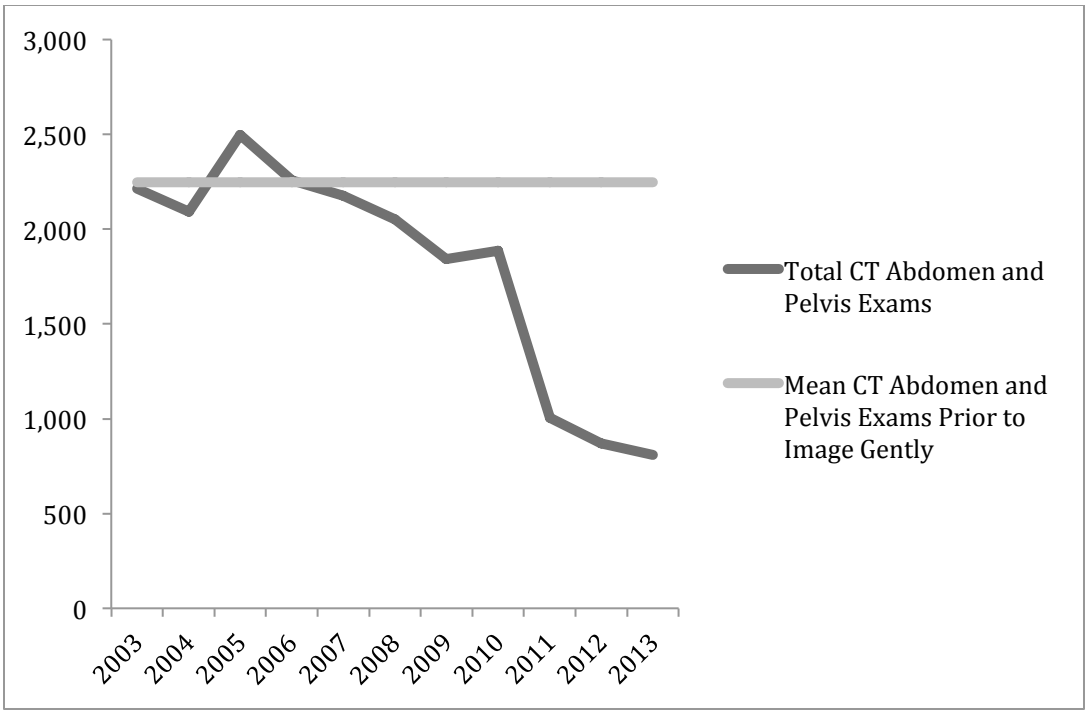

Figure 4: Line graph representation of total CT abdomen and pelvis examinations at Loma Linda University Medical Center from 2003 to 2013 with mean CT abdomen and pelvis exams prior to Image Gently.

In 2007, 37.5% of patients received an ultrasound as the initial examination for suspected appendicitis, while 62.5% received a CT as the initial imaging evaluation. In 2008, 50% received an ultrasound and 50% received a CT as the initial imaging evaluation. In 2013, 85.4% received an ultrasound and 14.6% received a CT as the initial imaging evaluation for suspected appendicitis (**Figure 5**).

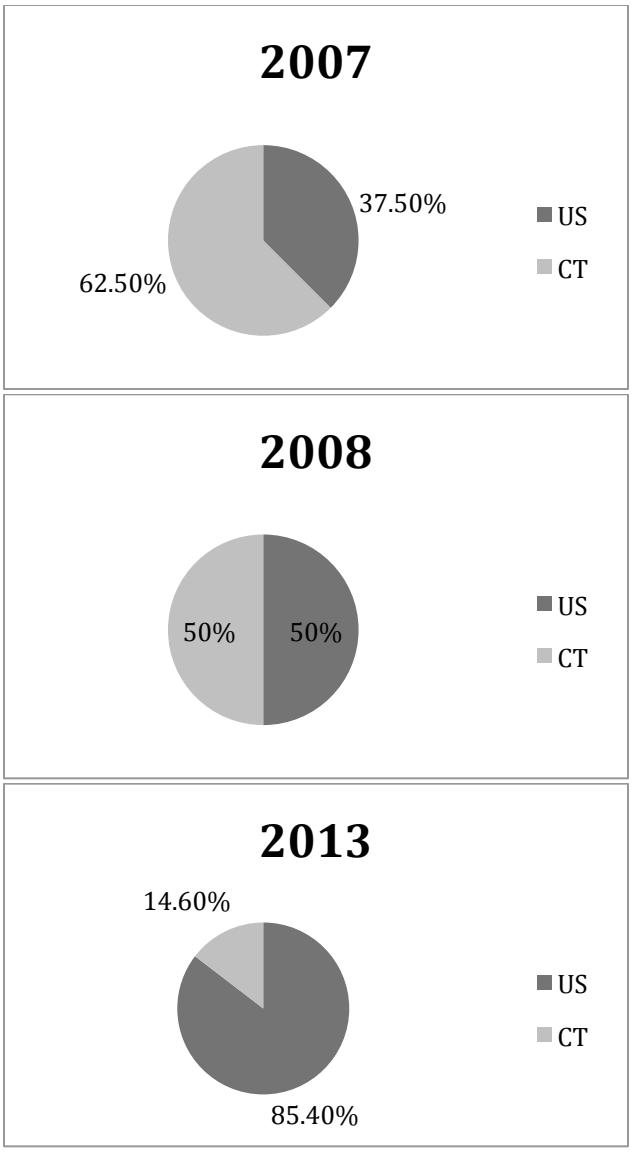

Figure 5: Pie chart representation of proportion of pediatric patients receiving an ultrasound or CT examination for the initial evaluation of suspected appendicitis in 2003, 2008 and 2013.

Discussion and Conclusion

Since the implementation of the Image Gently Campaign in 2008, the number of ionizing imaging examinations has steadily decreased at Loma Linda University Medical Center. Conversely, there has been a steady increase in the use of non-ionizing imaging examinations, such as MRI and ultrasound examinations. When comparing the mean prior to the Image Gently Campaign to data from 2013, there has been a 33% decrease in the number of CT examinations, a 19% decrease in the number of radiograph examinations, a 13% increase in the number of ultrasound examinations, and a 19% increase in the number of MRI examinations. While there has been a steady decline in the utilization of ionizing imaging examinations since 2005, there was a sharper decline in the utilization of ionizing imaging examinations since the Image Gently Campaign. This is particularly true of the number of CT

abdomen and pelvis examinations, which demonstrated a 64% decrease in 2013 from the mean prior to the Image Gently Campaign.

In pediatric patients presenting to the emergency department with suspected appendicitis, there has been a shift from the use of CT as the initial imaging examination for the evaluation of appendicitis to the use of ultrasound since the Image Gently Campaign. In 2007, 37.5% of patients received an ultrasound as the initial examination for suspected appendicitis, while 62.5% received a CT as the initial imaging evaluation. In 2008, 50% received an ultrasound and 50% received a CT as the initial imaging evaluation. In 2013, 85.4% received an ultrasound and 14.6% received a CT as the initial imaging evaluation for suspected appendicitis.

These findings suggest Loma Linda University Medical Center has been making an effort to perform more appropriate imaging examinations by keeping radiation and its adverse effects in mind. Since children are more sensitive and vulnerable to the biological effects of radiation received from imaging scans than adults, by utilizing non-ionizing imaging whenever possible and using imaging techniques to decrease radiation dose, the adverse effects of radiation on children can be minimized.[3]

The results of this study are in line with the previously published results from the 2013 retrospective study by Miglioretti et al. that reviewed the use of CT in children younger than 15 years of age from 1996 to 2010 across seven US health care systems, which included Kaiser Permanente and the Henry Ford Health System. The study found that the use of CT on older children nearly tripled from 1996 to 2005 to a peak of 27 CT scans per 1000 children. The increase in use was lower among younger children, with a doubling of use during the same period to 20 CT scans per 1000 children. The use of CT in the study population stabilized and slightly declined since 2007, particularly among younger children. The study attributed the decline to the increased awareness about the cancer risks from pediatric imaging in part due to the Image Gently Campaign. The decline in CT use in pediatric patients at Loma Linda University Medical center parallels the trend across the country.

While the data demonstrates a reduction in ionizing radiation imaging examinations since the Image Gently Campaign in 2008, there are limitations to this study. There are other reasons that might explain the reduced utilization of ionizing radiation examinations since 2008 other than the Image Gently Campaign, such as improvements in ultrasound and MRI technology as well as the availability of these imaging modalities. Change in reimbursement is another potential reason for the observed increased utilization of ultrasound and MRI examinations since 2008.

The risk of radiation-induced solid cancer is highest for CT scans of the abdomen and pelvis, which has seen the most dramatic increase in use, especially among older children.[5] The 2013 Miglioretti et al. study found that most of the CT abdomen and pelvis exams were done for pain (40%), possible appendicitis (11%) or infection (6%). Ultrasonography is a reasonable alternative for assessing appendicitis because of its high accuracy and because it does not use ionizing radiation. There is evidence that supports limiting pediatric CT use in this setting to patients with equivocal or negative findings of ultrasonography.[6] At Loma Linda

University Medical Center we found that there has been decreased utilization of CT as the initial imaging examination for the evaluation of appendicitis in pediatric patients and there has been increased utilization of ultrasound since the Image Gently Campaign. It is the hope that there continues to be increasingly more reliance on non-ionizing imaging in the future to reduce radiation-induced cancers from CT use in pediatric patients.

References

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