

## Patient Safety Tip of the Week

June 4, 2013

# Reducing Unnecessary CT Scans

For many years scientists have warned of the risk of radiation-induced cancers that might develop after exposure to radiation doses involved in medical tests such as CT scans. Those risks have been largely theoretical and based upon cancer rates in Japan following the nuclear bomb explosions in World War II.

In our April 2013 What's New in the Patient Safety World column "[Radiation Risk of CT Scans: Debate Continues](#)" we discussed two recent studies that had somewhat conflicting views of the risks of radiation at least as regards cancer risks.

One of the first studies to actually demonstrate such an increased risk attributable to CT scanning ([Pearce 2012](#)) showed that use of CT scans in children was associated with increased risks of leukemia and brain cancer. But the cumulative absolute risks were actually relatively small. In the 10 years after the first scan for patients younger than 10 years, one excess case of leukaemia and one excess case of brain tumor per 10 000 head CT scans were estimated to occur. The authors concluded that, although clinical benefits should outweigh the small absolute risks, radiation doses from CT scans ought to be kept as low as possible and alternative procedures, which do not involve ionizing radiation, should be considered if appropriate.

The other study ([Zondervan 2013](#)) showed the risk of death from underlying morbidity is more than an order of magnitude greater than death from long-term radiation-induced cancer. They looked at the reasons for CT scans and the mortality rates of the underlying medical conditions. They found that young adults who have had 1 or more computed tomography (CT) scans earlier in life are at significantly greater risk of dying from underlying medical conditions than from radiation-induced cancer.

Now a third study adds even more to the debate. Mathews and colleagues ([Mathews 2013](#)) reviewed data from an Australian database of over 11 million patients and analyzed the incidence of cancer in 680,000 young patients exposed to CT scans. Mean followup in these patients was almost 10 years. Compared to those not exposed to CT scans the incidence of cancer in those exposed to CT scans was 24% higher. Brain cancer had the highest risk but the risk for almost all cancers was increased (note that the previous study by Pearce et al. was not powered enough to determine whether cancers

other than brain cancer and leukemia were associated with CT scans). The risks were highest for those children having their first CT scan before age 5 years. Moreover, the risk of cancer increased further with each subsequent CT scan.

But two considerations are important in analyzing this study. First, the absolute increased risk of cancer associated with CT scans was still small overall (9.38 per 100,000 patients for all cancers). Secondly, the study did not have full data on reasons for the CT scans. Many of the patients may have had CT scans ordered because of symptoms or underlying conditions known to be associated with cancers.

So the debate about the magnitude of the problem of unnecessary exposure to ionizing radiations continues. Nevertheless, our continued efforts to reduce patient exposure to unnecessary ionizing radiation, particularly in the youngest patients, makes sense.

There are several potential ways in which the collective dose of radiation might be reduced:

- Avoiding unnecessary imaging studies that utilize ionizing radiation
- Using alternative imaging studies that do not utilize ionizing radiation
- Reducing dose of radiation for individual imaging studies
- Prior authorization of imaging studies
- Use of clinical prediction rules
- Clinical decisions support tools
- Audit and feedback
- Systems for tracking cumulative radiation exposure for individual patients

While we still have not seen a national system for **tracking cumulative radiation doses**, there appears to have been a slight reduction in the rate of growth of CT scanning in the past couple years. Whether that is due to the Image Gently or Image Wisely campaigns or due primarily to the economic slowdown remains unclear.

While the bulk of our efforts should really be directed at avoiding unnecessary scans it also makes sense to minimize the exposure to ionizing radiation when a scan is really necessary. Since the series of incidents in which patients undergoing CT scanning were exposed to extremely high radiation doses (see our February 2, 2010 Patient Safety Tip of the Week “[The Hazards of Radiation](#)”) most hospitals have reviewed their CT scanning protocols and many have successfully **reduced the radiation doses without reducing the clinical quality of the scans**. So the radiation dosage from a single CT scan today may be considerably less than those done even 3 or 4 years ago.

One group used a multidisciplinary committee in a community hospital setting to reduce patient radiation dose, repeat rate, and variability in image quality ([Siegelman 2013](#)). The committee included radiologists, technologists, consultant medical physicists, and an administrator. This was really a proof-of-concept study that demonstrates it is possible to produce such improvements in quality and patient safety.

But our primary strategy to reduce the risks of radiation is still **reducing the inappropriate use of imaging studies that use ionizing radiation**. On several occasions we have talked about the Image Gently or Image Wisely campaigns, the purpose of which is to minimize the unnecessary exposure of patients to radiation (see our February 2, 2010 Patient Safety Tips of the Week “[The Hazards of Radiation](#)” and November 23, 2010 “[Focus on Cumulative Radiation Exposure](#)” and our What’s New in the Patient Safety World columns for March 2010 “[More on Radiation Safety](#)” and June 2011 “[Progress in Reducing Radiation from CT Scans](#)”).

We don’t do a particularly good job of **explaining the potential risks and benefits of CT scans to patients**. A recent survey of patients undergoing CT scans showed that only 17% of patients said that the risks and benefits were explained and they were given the opportunity to participate in the decision with their physician about whether to order the scan ([Caverly 2013](#)). 62% felt that the decision to order the scan was mainly the physician’s. Only a small percentage were able to state what the risks of radiation were. Also, notably absent in the discussions before the exams were the potential risks that might be associated with incidental findings.

**Audit and feedback** may be helpful in reducing unnecessary CT scans. We’ve seen several emergency departments that significantly reduced the variation in CT ordering rates by individual physicians simply by providing the individual statistics at their monthly departmental meetings.

In our November 23, 2010 Patient Safety Tip of the Week “[Focus on Cumulative Radiation Exposure](#)” we noted that use of **clinical decision support rules** is a good way to minimize the number of unnecessary CT scans as well as reduce costs. We noted the multitude of such rules available for determining when to perform head CT scanning in patients with minor head injuries. Recently, a promising clinical decision support rule for deciding whether to perform abdominal CT scans in children presenting to the emergency department with blunt abdominal trauma was developed ([Holmes 2013](#)).

**Conditional imaging strategies** (see our August 2009 What’s New in the Patient Safety World column “[Imaging for Acute Abdominal Pain](#)”), such as performing ultrasound first in children with acute abdominal pain and only doing CT scans if the ultrasound does not provide a diagnosis, may help reduce unnecessary CT scans. However, a shortage of ultrasound techs has left many community and rural hospitals without ultrasound coverage at night. There remains great variation across hospitals in the rates of abdominal CT scans in children with abdominal pain. More and more we will see that appearing as a measurement parameter of quality and patient safety.

Use of **clinical decision support tools at the time an imaging study is being ordered** is a logical opportunity to improve appropriateness of studies ordered. Previous studies looking at the impact of computer-generated alerts on test ordering in general have had mixed results. But several recent studies have demonstrated some promising results. Researchers at Brigham and Women’s Hospital in Boston examined the impact of providing decision support alerts regarding potential duplicate studies to providers

ordering CT scans ([Wasser 2013](#)). The alerts noted any CT scans done on the same body part within the past 90 days and provided links to images and radiology reports. Such alerts for a potentially duplicate CT scan appeared for a third of CT orders. Those who received the alerts cancelled their CT scan order 6.0% of the time compared to only 0.9% in a control group of providers not receiving the alerts. The cancellation rates varied considerably by site, being 19.3% in primary care clinics.

Another study, done as a simulated exercise, looked at the impact of alerts about radiation dose or imaging costs on test ordering ([Gimbel 2013](#)). In this exercise 112 family physicians (about 2/3 of whom were residents) were presented with a hypothetical case of a 22 y.o. woman who had previous detection of a renal mass. They were asked what imaging study they would order next. They would make their choice. Then appropriateness criteria from the ACR were shown and they could change their choice. Then they were presented with a decision support alert regarding either radiation dose or test cost (randomly assigned to which type of information was presented first) and allowed to change their choice again. Seeing the ACR appropriateness criteria caused only slight changes in imaging choices. But in the group presented with radiation dose information first (65 physicians), the number of CT scans ordered dropped from 32 to 14. Information about cost of the CT did not further reduce CT orders. However, ultrasound orders increased from 25 to 36 after radiation dose information was presented and then further increased to 45 after cost information was provided. MRI's dropped to none. The group that received cost information first (47 physicians) increased ordering a CT scan from 26 to 29 after seeing the ACR criteria but this was reduced to 16 after cost information was presented and then 15 after radiation dose was provided. The authors conclude that information about radiation dose and cost can influence physicians' ordering patterns for imaging studies. But they also note that the order in which the information is presented is important. Those given radiation dose information first changed their ordering to ultrasound at the expense of CT or MRI. Those given cost information first significantly reduced their CT ordering in favor of ultrasound but did not further modify their choices when presented with radiation dose information.

Admittedly, this was a simulated exercise in a hypothetical patient. We don't know if we'd see the same impact in a real-life setting. However, the results are very promising and certainly suggest that clinical decision support (CDS) might help us reduce both radiation dose and cost.

And don't forget that CT scanning is not the only imaging study where radiation dose is a significant consideration. Cardiac imaging is another significant source for radiation to patients. Fortunately, such cardiac imaging is seldom done in the childhood and early adult patients in whom the cumulative risks of radiation of most concern. But recent evidence suggests we can also reduce the number of such cardiac imaging studies by using clinical decision support tools ([Lin 2013](#)). The authors studied the impact of an automated multimodality point-of-order decision support tool on appropriateness. They found that inappropriate testing decreased from 22% to 6% and appropriate testing increased from 49% to 61% after implementation of the tool. Intended changes in medical therapy also increased from 11% to 32%.

Managed care organizations have for many years utilized prior authorization for expensive studies like CT and MRI imaging. These have been successful at reducing overall rates for both types of imaging. But they have also led to more appropriate choice of the initial imaging study and reduced the “layering” of studies. Such programs may steer the ordering physician to a more expensive MRI scan rather than a CT scan when the MRI is the more appropriate study. They use algorithms similar to the ones underlying the clinical decision support tools noted above in the Lin study. However, compared to the inefficiencies of using the prior authorization phone calls, the tool used by Lin et al. took only about 2 minutes to complete.

**But don’t be so overly concerned about the risk of the radiation dose that you forgo imaging studies that will truly add to the clinical management process.** One of the studies noted above ([Zondervan 2013](#)) showed the risk of death from underlying morbidity is more than an order of magnitude greater than death from long-term radiation-induced cancer. Another study in this month’s American Journal of Roentgenology ([Pandharipande 2013](#)) shows that even radiologists may be confused about the risk of radiation dose. That study used a survey of physicians (residents, fellows, and attendings) presented with a hypothetical patient who had a history of multiple CT scans and now was being considered for another abdominal CT scan. The authors make the case that the “linear, no-threshold model” (for cancer risk from radiation) actually should lead to consideration only of the current examination, not the previous ones. Yet 92% of the respondents admitted that the prior history of radiation exposure influenced their decision even though most (61%) reported accepting the “linear, no-threshold model”. The authors caution that such concerns could lead to decisions to use other imaging modalities that might not provide the most appropriate information.

The [Mayo Clinic has a good 5-minute video presentation](#) on YouTube on talking points you can use with your patients regarding the radiation risk of imaging studies. It compares radiation dosages in today’s studies (where reduced dosages are now commonplace) to ambient radiation exposure. It appropriately acknowledges the two sides of the CT radiation dose/cancer risk debate and puts it in perspective for both physicians and patients.

**Some of our previous columns on the issue of radiation risk:**

- February 2, 2010      [“The Hazards of Radiation”](#)
- November 23, 2010    [“Focus on Cumulative Radiation Exposure”](#)
- March 2010            [“More on Radiation Safety”](#)
- June 2011             [“Progress in Reducing Radiation from CT Scans”](#)
- April 2013             [“Radiation Risk of CT Scans: Debate Continues”](#)

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Mayo Clinic video “Doing More with Less: Radiation Doses Dropping”

<http://www.youtube.com/watch?v=UI4u0UYZwsA&feature=youtu.be>



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