

## To X-ray or not to X-ray? That is the question

### 22.011 Op-Ed

Rahi Patel

There are a number of possible outcomes that can result when you run full speed into a fence. In my case, my foot took the brunt of the force. While the pain was not excruciating, my swollen foot could barely fit into my sneaker. Was the foot broken? The only way to find out was a dose of radiation right to the affected limb: an X-ray examination.

The X-ray image revealed a small fracture in my foot providing the doctor and I with valuable insight into how to heal the foot. I was fine within a month of wearing a boot. The big question I thought about afterward was, am I fine in general? Did the X-rays beamed into my foot do some lasting damage to my health? Did knowing what happened to my foot come at the expense of cancer later on in life?

It did not occur to me to ask these questions at the time of the X-ray. I always assumed X-ray exams were fine. But after learning about radiation in my nuclear science class, I started questioning how safe those X-rays were. Should I have gotten that X-ray exam? The answer is most likely. I've learned that the science is unclear on how an X-ray exam affects your chances of developing cancer, but in most cases, it probably doesn't change them that much. Most of the time, the benefits of getting an X-ray far out-weigh the risks.

There are several kinds of medical examinations that use X-rays to achieve their purpose and some use more than others. Therefore, before we can reasonably understand the risk, we need to establish a unit. Enter the Sievert. It's a unit used to measure how harmful a given source of radiation is to you based on the amount of radiation, type of radiation, and part of body being irradiated. We also need a baseline number to compare these numbers to. A good baseline is the average background radiation levels you receive on a yearly basis from the environment of roughly 3.2 milli-Sieverts (mSv) per year. It's roughly the level of radiation we and our fellow earth creatures evolved in. So whatever danger that poses, it has been with us throughout the entirety of human history. What danger does additional radiation to this background level pose?

Based on many studies done over the years, scientists estimate that a dose of 100 mSv in addition to background levels can increase your chance of getting cancer in life by 1% (lifetime cancer risk). The scientists also estimated that your risk decreases in proportion to your radiation dose. Using this as a baseline, radiation amounts from medical X-ray examinations can range from an average of .001 mSv to 1.5 mSv depending on the area of image (e.g. leg vs. spine). CT scans tend to use more X-ray radiation ranging from an average of 2 – 16 mSv because they take multiple X-ray images per scan. While some of these values are well below our 100 mSv benchmark, some procedures hover dangerously close. But the picture isn't actually this clean. This estimate of 100 mSv increasing your lifetime cancer risk by 1% comes

with a caveat. Due to lack of sufficient data, this estimate could be a factor of 2 or 3 larger or smaller. We simply don't have enough study subjects to have a better answer.

Given this uncertainty, I think the question to ask is if the potential risk of radiation is lower than the risk to your immediate health if you do not get the X-ray or CT scan. In most cases, the answer is yes. Most X-ray exams seem safe considering how small the radiation dose is compared to background levels. Looking back to my foot X-ray, I'm pretty confident I don't have anything to worry about. For CT scans, however, due to the higher amounts of radiation used, a little more caution is required. It's probably best to determine with your doctor how crucial the CT scan is. What is the purpose of your CT scan? If it's used to diagnose a potentially imminent health condition, the benefit likely outweighs the lifetime cancer risk.

I didn't consider the risks of the X-ray examination when my foot was being diagnosed. Luckily for me, the dose of radiation I received was insignificantly low. But it's possible that in the future, I may need a CT scan. In that case, I will likely be more cautious of the higher doses of radiation. Although the cancer risk is likely small, I want to be absolutely certain that I'm taking that risk for good reason. To X-ray or not to X-ray? That is the question I should've asked my doctor before. I will not make the same mistake in the future.

MIT OpenCourseWare  
<https://ocw.mit.edu/>

22.011 Nuclear Engineering: Science, Systems and Society  
Spring 2020

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.