Sources of radiation and keeping you safe at the dentist!

Are you a resident of Toronto, Canada? Have been for at least a year? Well, you have likely received an effective radiation dose equal to 1.8 millisieverts [1]! *Wait… what?* Let’s dive into what this means.

Radiation sources can be found everywhere, and there’s no way to completely avoid them. There are two different types: *non-ionizing* and *ionizing* radiation. The first is commonly used to heat up your food (microwaves) or to help you listen to the radio (radio waves). These types of waves are relatively low in energy; more specifically, they don’t have enough energy to *ionize* matter. This means that the radiation you encounter from, say, your microwave or your radio is unable to eject electrons from an atom. Ionizing radiation, on the other hand, carries enough energy to be able to ionize matter; depending on the amount of ionizing radiation you’re exposed to, the resulting ionization can potentially damage tissues in your body. That being said, we encounter ionizing radiation day-to-day; some natural sources include cosmic rays, soil, rocks, the food we eat, and the air we breathe. So, how do we measure the amount of ionizing radiation that someone can be safely exposed to?

The amount of ionizing radiation that one may receive can be quantified in three ways [1,2], and their relationship to one another is summarized in Figure 1.

1. Absorbed dose (Units: Grays)

This describes the amount of energy that interacts with a material (in this case, we’ll focus on human tissue).

1. Equivalent dose (Units: Sieverts)

There are four subtypes of ionizing radiation (alpha, beta, gamma, x-rays). These subtypes interact with tissue differently and so they inflict varying degrees of tissue damage. To be able to directly compare them, the *absorbed dose* is scaled by a radiation weighting factor to give us the *equivalent dose*, allowing us to directly compare the effects of each radiation subtype.

1. Effective dose (Units: Sieverts)

Similar to (2), different organs will absorb radiation differently given the same *equivalent dose*. This dose is scaled by a tissue weighting factor to give us the *effective dose*, allowing us to describe the effect of the same equivalent dose for different parts of the body [1,2].

Diagram, text

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Figure 1: Summary of the relationship between the ways in which ionizing radiation is quantified.

There you have it – someone in Toronto can expect to receive an effective dose of 0.0018 Sv, or 1.8 mSv and this is attained primarily through the natural sources of ionizing radiation mentioned above [1]. A full list of the effective dose you might receive per year in other major cities across Canada is provided [here](https://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm), by the Canadian Nuclear Safety Commission (CNSC).

But apart from natural sources, there are also artificial (i.e. man-made) sources of ionizing radiation that one may be exposed to. Sources include medical examinations (x-ray or computed tomography (CT) scans), travelling on a plane, or other industrial settings such as a nuclear power plant [1]. You won’t always be able to avoid the additional doses from these artificial sources. So then, how can we protect ourselves from radiation sources? There are three essential principles governing radiation safety [3]:

1. Time – we can reduce the time we spend exposed to an artificial source
2. Distance – we can move farther away from the source
3. Shielding – we can use physical barriers that block the radiation source and absorb the radiation being emitted

A desk in front of a mirror

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Now, let’s use what we’ve discussed in an example. If you’ve ever gone for a routine dental examination, the dentist may have taken an x-ray of your teeth. In this case, a typical dental x-ray exposes someone to 0.005 mSv (360 times less than background radiation [1].Though the dose is small, there are measures put in place to protect the patient even further, as radiation protection strives to keep exposures “as low as reasonably achievable” (ALARA) [1].

You may have noticed that the dentist or dental assistant leaves the room when the x-ray is being taken- this ensures that the radiation is delivered only to those who are intended to receive the x-ray. This is related to the concept of distancing and shielding the dentist/dental assistant from possible radiation exposure. Next, the x-ray scan is taken quite quickly to reduce the radiation emission. This also helps with acquiring better x-ray images - the longer the scan, the more the patient is likely to move, which can degrade the image quality. Lastly, you know that heavy apron the dental staff puts on you before leaving the room? That apron is made out of lead and is designed to shield the rest of your body from x-rays, further reducing any unnecessary exposure to ionizing radiation.

If you’re interested in reading more into how dentists in Ontario keep their patients safe during x-ray examinations, I recommend this [article](https://www.rcdso.org/en-ca/rcdso-members/dispatch-magazine/articles/1393) written by the Royal College of Dental Surgeons of Ontario. A more detailed document is provided [here](https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/radiation-protection-dentistry-recommended-safety-procedures-use-dental-equipment-safety-code-30.html), by Health Canada.

I hope that throughout this read you’ve learned more about radiation sources, and hopefully at your next dental check-up, you’ll notice the things we’ve discussed that keep you safe at the dentist!

References

[1] Canadian Nuclear Safety Commission. (2019, September 12). *Radiation Doses.*

https://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm

[2] Harrison, J., & Lopez, P. O. (2015). Use of effective dose in medicine. *Annals of the ICRP*, *44*(1\_suppl), 221–228. https://doi.org/10.1177/0146645315576096

[3] Kim J. H. (2018). Three principles for radiation safety: time, distance, and shielding. *The Korean journal of pain*, *31*(3), 145–146. https://doi.org/10.3344/kjp.2018.31.3.145