In this age of medical advances, one branch that has seen giant leaps forward is radiation medicine. However, along with these advances comes increasing fears as myths of radiation exposures take hold. As with any fear, education can help keep people safe while also dispelling any misconceptions.

An interview with Ray Dielman, Radiation Safety Officer and medical health physicist to hospitals and clinics in St. Petersburg, Florida, revealed the facts about nuclear medicine, how it works, who is at risk for exposure, and how to watch out for one’s own safety.

The truth is that we are all exposed to radiation every day. This is called environmental or background radiation and it comes from the world around us, from the sunshine you enjoy while walking to get the mail, to the banana you had for breakfast. The average person in the United States is exposed to about 300 millirem (or mrem, a unit of measure of radiation) per year, although it varies by location. For instance, residents in higher elevations such as Denver, Colorado will be exposed to more than a low-lying coastal area, sometimes as high as 1,000 mrem. In the United States, the government has determined that general public should not receive more than an additional 100 millirems per year over the background.
However, in the hospital setting, things are a bit different, because patient radiation exposure should be dictated by appropriateness of the procedure. There is no limit to how many millirem someone receives while a medical patient. Occupational workers, such as radiographers, radiological scientists, nuclear medicine technicians, radiation safety officers (RSOs), and cardiovascular technicians, can have an additional 500 mrem on top of the 300. Non-occupational medical workers, such as nurses, housekeeping staff, or EMTs, are still limited to the additional 100 mrem. *10% of the maximum=m exposure of 5000 millirem.

Types of Radiation

There are two sources of ionizing radiation: 1) that which comes from Radiation Producing Equipment (RPE), and 2) that which comes from Radioactive Material (RAM).

RPE exposures can happen during xrays, dentist appointments, general surgery, cardiac catheter procedures, etc. However, Ray Dielman suggests we think of these exposures like a light bulb. The device turns on and off, and radiation is only present when it is on. It does not linger in the patient or surrounding materials.

RAM exposure, on the other hand, is like a battery – the juice is always on. This is the type of radiation exposure that requires caution by caregivers. RAMis used in nuclear medicine, positron emission tomography (PET) and radiation therapy (i.e. seeds).

Nuclear medicine utilizes radio pharmaceuticals, which is a radio nuclide combined with a drug. These are administered either orally or via intravenously (IV). PET is a nuclear medicine imaging technique, customarily used to stage cancer patients. Another type of radiation medicine is brachytherapy, which are encapsulated sources of radio nuclides that are implanted within the body to treat cancer. The use of these diagnostic and therapeutic techniques is relatively safe, as long as they are used in strict accordance with established and approved policies and procedures.

Comparing Millirem (mrem)

<table>
<thead>
<tr>
<th>Procedure / Year</th>
<th>Description</th>
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<tbody>
<tr>
<td>15/procedure</td>
<td>The amount of exposure from a chest x-ray. Total Body</td>
</tr>
<tr>
<td>300/procedure/Skin; 5</td>
<td>The amount of exposure from a dental x-ray.</td>
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<tr>
<td>300/year</td>
<td>Average background or environmental radiation amounts (baseline). This amount varies by location.</td>
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<tr>
<td>100/year</td>
<td>The additional amount above baseline that the federal government has deemed acceptable for the general public.</td>
</tr>
<tr>
<td>500/year</td>
<td>The additional amount above baseline that the federal government has deemed acceptable for occupational workers.</td>
</tr>
<tr>
<td>400-1,000/year</td>
<td>The baseline of people in higher elevation areas.</td>
</tr>
<tr>
<td>20,000/treatment</td>
<td>The overall amount a patient’s body is exposed to during iodine 131 treatment.</td>
</tr>
<tr>
<td>25,000/mission</td>
<td>The amount space shuttle astronauts are exposed to during one mission.</td>
</tr>
<tr>
<td>Unlimited</td>
<td>Amount that a medical patient can receive in various procedures and tests.</td>
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Sources: Massachusetts Institute of Technology and Washington Department of Health.
Shelf life, or half life, is the time it takes for a RAM to lose half of its radioactivity, or as more commonly known, to decay to half its potency. The average shelf-life for nuclear medicine radio pharmaceuticals is six hours, while PET shelf life is two hours. Others are significantly longer, such as iodine 131, which is used in treating hyperthyroidism and thyroid cancer. It has a shelf life of eight days.

**Minimizing Risks**

Occupational workers employ five strategies in dealing with radiation risks:

1. **Time** – Minimizing the time spent around a patient under treatment or RAM source greatly reduces exposure risks.
2. **Distance** – Exposure risks are reduced exponentially as workers distances themselves from the patient or RAM source.
3. **Shielding** – Workers utilize lead shielding in many ways. They wear lead aprons and X-Ray rooms are lead lined. Plastic shelled lead storage containers for radioactive material, known in the industry as “pigs” house radio pharmaceuticals or exposed materials.
4. **Dilution** – Dilution in water reduces the exposure risk.
5. **Decay** – As already discussed, waiting out the shelf life eventually allows the radioactive source to decay to acceptable levels.

In the case of iodine 131 treatment, the patient is usually put in a private corner room that may be lead lined (shielding). The head of bed does not go against a wall that is shared with another room (distance). The patient is often monitored from the doorway, or via telephone or video, and is escorted out of the hospital with minimal contact at the end of treatment. Only the radiation safety officer (RSO) enter the room and only when necessary (time) to monitor the patients radiation levels. All supplies, food, etc. taken into the room do not come out, as most items used are disposable.

One of the primary risks of these types of treatment is exposure due to patient excretions, predominantly urine. Because of this, linens do not leave the room until they can be removed by the RSOs and are taken to long term storage to wait out their half life. For iodine 131, the quarantine time is ten half lives, or eighty days. The linens are monitored until they go back to environmental levels. At that point they may go into general laundry.

PET has a shorter half life, only two hours, but has very high intensity. Because of this, the patient will be cared for twenty-four hours using time and distance precautions. If there is an issue with incontinence or other excretion issues early in the period, the RSO should be called to monitor the linen. Once that twenty-four hour period is over, the linens are safe to be handled in general laundry, unless there are biological concerns, such as urine or blood, in which case they would be handled as biohazard.

What does all this mean to the laundry worker?

Because the only staff handling the linens immediately after exposure is the RSOs, non-occupational hospital or laundry workers are not usually trained to think about linens exposed to radiation. While the precautions in place minimize the risks,
it is still beneficial for general hospital and laundry staff to be aware of the facts. The linens that were exposed to radiation will not be marked in any special way, and are transported in regular linen bags, unless they were deemed biohazards. While there is always the chance that radiated linens might make it to the laundry, Dr. Dielman reminds us that “dilution is the solution.” Once the linen has been through the wash and rinse cycle, the risks are basically eliminated. Remembering that non-occupational workers can receive an additional 100 mrem over baseline per year, the chances of suffering ill effects from radiated linens is minimal.

All laundry workers should be vigilant as to potential risks of any sort. If an implanted RAM device, such as used in brachytherapy, were to become dislodged and fell into the linens undetected by the hospital staff, there would be the risk of exposure. This is no different than the risk of biohazard materials or sharps making it to the laundry. Because of this, laundry workers should remember to stay on high alert and to not be afraid to call attention to anything unusual found in the linens.

Dr. Dielman concedes that laundries that service high risk facilities, such as cancer centers that utilize high amounts of radiation therapies, may do well to periodically assess radiation levels. However, unless a high amount is detected, he sees no reason for constant monitoring to be necessary.