CD Summary

March 29, 2011
Vol. 60, No. 7

Telephone 971-673-1111
Fax 971-673-1100

cd.summary@state.or.us
http://oregon.gov/dhs/ph/cdsummary

OREGON PUBLIC HEALTH DIVISION • OREGON HEALTH AUTHORITY

EVERYTHING YOUR PATIENTS WANT TO KNOW ABOUT RADIATION*

(*AND AREN'T AFRAID TO ASK)

On March 11 at 2:46 P.M. local time† a magnitude-9.0 earthquake struck 109 miles east of Fukushima off northeastern Honshu, Japan. In addition to destroying many communities and leaving more than 20,000 dead or missing, the earthquake and resulting tsunami knocked out cooling systems at the six-reactor Fukushima Daiichi nuclear power plant. As this issue goes to press, the conditions at the plant remain serious but appear to be coming under control. Radiation releases have endangered workers attempting to control the situation at the plant,[1] but in the absence of a large, explosive release of radiation, the 4,643 miles between Astoria and Fukushima make it very unlikely that Oregon will see levels of radiation that pose a health risk from this event. As expected, routine monitoring of environmental samples has detected trace amounts (about 100 nanorems) of iodine 131 and other radioactive isotopes from Japan — well below any level of concern (Box); but your patients may have questions nonetheless. In this issue of the *CD Summary*, we review basic information about ionizing radiation, the health effects it can produce, and what we can do about it should a risk for significant exposure ever arise here in Oregon.

RADIATION RISK FACTORS

The risk of illness from radiation depends upon the amount and type of radiation, the duration of exposure, the route by which exposure occurs, and the age of the person exposed.

The **amount** of radiation released in an event depends on how much radioactive material is present and on the force with which it is dispersed. The disaster at Chernobyl, Ukrainian SSR in 1986 featured run-away fission, followed by a large explosion that demolished the containment structure around the reactor, and dispersed radioactive material thousands of feet into the atmosphere, spreading medically significant amounts of it up to 500 km away.[2] Nothing like that happened in Fukushima.

Three **types** of ionizing radiation: alpha, beta and gamma, are relevant. From high school chemistry you will recall that when a radioactive substance decays, it can release alpha particles, i.e. two protons and two neutrons; beta particles, i.e. electrons; or gamma rays, i.e. photons. (For more information on these, type "IAEA radior" into an Internet search engine.)

> **How much is 100 nanorem?**
>
> - 1/500,000th of the dose acquired from rocks, bricks and sun in a typical day
> - 1/100,000th of the radiation received from a typical chest x-ray
> - 1/50,000,000th of the anticipate dose at which potassium iodide is recommended for infants (5 rems)
> - After 80,000 years of exposure at this level, potassium iodide is recommended

The **duration** of exposure is also important. Cumulative exposure is the key risk factor for the chronic health effects of radiation, and many of the commonly used measures to gauge health effects describe degree of exposure per unit time.

The **route** of exposure — how radioactive particles come into contact with the body — affects exposure duration and has an independent effect on risk of radiation-induced illness.

External exposure occurs when particles are released into the air and then fall onto surfaces. Radioactive isotopes can be easily washed from skin and other surfaces, but if left on the skin in large amounts and for prolonged periods, they can lead to burns. The main risk to human health, however, comes from internal exposure.

Internal exposure results from:
- Inhaling particles in contaminated air, or
- Swallowing particles in contaminated food or water.

Age: Children are growing and developing, and as a consequence are at higher risk of adverse health effects from radiation. (This is true not only in exposures that might result from an accidental radiation release, but also from radiological imaging.)

ISOTOPES BEHAVING BADLY

Several radioactive fission products could be released from a reactor, but three are of particular concern: iodine 131, cesium 137, and strontium 90. These are produced in quantities sufficient to cause illness in the setting of a large radiation release, and they can "volatilize" and spread if a large explosion leads to high-altitude, broad dispersion. In addition, their half-lives are long enough that they could stick around to do some damage. "Nuclear half-life" refers to the amount of time it takes for half of the isotope to decay into other elements. This is different from the biological half-life, which is the amount of time needed for half the isotope load to be excreted from the body.

^{131}I is easily absorbed by the body if it is ingested or inhaled, and concentrates in the thyroid gland. Its nuclear half life is only 8.1 days, but its accumulation in the thyroid can lead to several forms of thyroid disease, including cancer.[3]

^{137}Cs has a half-life of 30 years. The body handles it like potassium, so if it is ingested, it is distributed throughout the soft tissues. It can increase the risk for a variety of soft-tissue cancers.[4]

^{90}Sr (half-life 29 years) is handled by the body like calcium. Though 70%–80% of it is excreted, the remaining 20%–30% of ingested ^{90}Sr is incorpo-

† 9:46 P.M. on March 10 Pacific Standard Time

The **CD Summary** (ISSN 0744-7035) is published biweekly, free of charge, by the Oregon Health Authority, Office of Disease Prevention and Epidemiology, 800 NE Oregon St., Portland, OR 97232
Periodicals postage paid at Portland, Oregon.
Postmaster—send address changes to:
CD Summary, 800 NE Oregon St., Suite 730, Portland, OR 97232

CD SUMMARY
March 29, 2011
Vol 60, No. 7

PERIODICALS POSTAGE
PAID
Portland, Oregon

Oregon Health Authority

If you need this material in an alternate format, call us at 971-673-1111.

IF YOU WOULD PREFER to have your *CD Summary* delivered by e-mail, zap your request to *cd.summary@state.or.us*. Please include your full name and mailing address (not just your e-mail address), so that we can purge you from our print mailing list, thereby saving trees, taxpayer dollars, postal worker injuries, etc.

rated into bones and teeth. Significant exposure is associated with increased risk of leukemia, bone cancer, and cancers of the soft tissues adjacent to bone.[5,6]

HEALTH EFFECTS: ACUTE AND CHRONIC

Acute Radiation Sickness occurs following exposure to a massive dose of radiation in a short time, as happens near a nuclear bomb explosion or very close to a severe nuclear power plant accident. Historical examples of victims of such exposure include the first responders at Chernobyl; residents of Hiroshima and Nagasaki; and Louis Slotin and Harry Daghlian, two Manhattan Project scientists who were exposed to acute, lethal doses of radiation during experiments at Los Alamos, New Mexico, during 1945–1946.[7]

Acute radiation sickness begins within minutes to hours of exposure and can include:

- Nausea, vomiting and diarrhea
- Skin burns or rashes
- Bone marrow toxicity, with subsequent bleeding and risk of infection
- Death

Chronic Health Effects from radiation exposure reflect a person's total exposure over time. This includes radiation from the natural environment, from x-rays or CT scans, and from other sources.

- Radiation exposure over time can increase the risk for leukemia and cancers of the breast, thyroid, and lung, among others.
- Exposure of a pregnant woman in the first trimester can increase the risk of birth defects in the child, although the greatest risk in this setting is miscarriage.
- In some cases, radiation may cause mutations in a parent's DNA, leading to genetic illness in the child of an exposed person.

COUNTERMEASURES TO AVOID EXPOSURE AND ILLNESS

We won't be needing these in the foreseeable future, but there are a few simple strategies that could be used to decrease the likelihood of exposure and illness, should the need for them arise. These include staying indoors ("sheltering in place") if radiation levels become high; or evacuating if recommended by public health authorities. Persons exposed to >3,000 millirems of ^{137}Cs can take Prussian blue, a prescription medicine that binds cesium in the gut, speeding its elimination from the body and decreasing its biological half-life from 110 days to about 30 days.[8,9] Persons exposed to ^{131}I can take potassium iodide to saturate the thyroid with iodine, thereby decreasing uptake of the radioactive isotope. The recommended threshold for treatment in pregnant women and in children <18 years of age is an anticipated ^{131}I exposure of ≥5,000 millirems. Due to decreased sensitivity to the carcinogenic effects of this isotope, thresholds for treatment in adults are higher.[10]

CONCLUSIONS

You can reassure your patients that the risk to Oregonians, and, hence, the need for any of these countermeasures in response to the situation in Japan, is negligible.

FOR MORE INFORMATION

Advise your patients to call our information line at 877-290-6767; or to check our web site: http://public.health.oregon.gov/Preparedness/CurrentHazards/Pages/index.aspx

REFERENCES

1. International Atomic Energy Agency. Fukushima nuclear accident update log. www.iaea.org/newscenter/news/tsunamiupdate01.html. Accessed 25 Mar 2011.
2. International Atomic Energy Agency. Frequently asked Chernobyl questions. www.iaea.org/newscenter/features/chernobyl-15/cherno-faq.shtml. Accessed 20 Mar 2011.
3. CDC. Radioisotope brief: Iodine-131. www.bt.cdc.gov/radiation/isotopes/pdf/iodine.pdf. Accessed 20 Mar 2011.
4. U.S Environmenal Protection Agency. Cesium. www.epa.gov/radiation/radionuclides/cesium.html. Accessed: 20 Mar 2011.
5. U.S Environmenal Protection Agency. Strontium www.epa.gov/radiation/radionuclides/strontium.html. Accessed 20 Mar 2011.
6. Agency for Toxic Substance and Disease Registry. Interaction profiles: introduction www.atsdr.cdc.gov/interactionprofiles/IP-08/ip08-c1.pdf. Accessed 20 Mar 2011.
7. Alsop S. The strange death of Louis Slotin. Saturday Evening Post, Mar. 6, 1954.
8. CDC. Prussian blue fact sheet. www.bt.cdc.gov/radiation/prussianblue.asp. Accessed 21 Mar 2011.
9. U.K. Health Protection Agency. Use of Prussian Blue for decorporation of radiocaesium. www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1274091555595. Accessed 21 Mar 2011.
10. U.S Food and Drug Administration. Guidance: potassium iodide as a thyroid blocking agent in radiation emergencies. www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/ucm080542.pdf. Accessed 20 Mar 2011.