

CENTER FOR DISEASE PREVENTION & EPIDEMIOLOGY • OREGON HEALTH DIVISION

MEDICAL AFTERMATH OF THE HANFORD PROJECT

BETWEEN 1944 AND 1972, the Hanford Site in southeastern Washington released radioactive materials into the air and the Columbia River while producing plutonium for nuclear weapons. More than two million people living during these years in the areas downwind and downstream from Hanford were exposed. Most residents did not learn about past radiation releases until 1986.

Years of secrecy about past exposures have caused mistrust and frustration as citizens attempted to learn more about potential health impacts. Many persons who lived in the exposed area now report health problems they believe may be related to past radiation releases. To help answer scientific and health-related questions about Hanford's radioactive releases, the federal government established three projects:

- 1) The Hanford Environmental Dose Reconstruction Project, a scientific study charged in 1987 with calculating individual dose estimates people may have received from Hanford's past releases (see map, *verso*).
- 2) The Hanford Thyroid Disease Study (HTDS), an epidemiologic study begun in 1988 to determine whether thyroid disease (including abnormal function, benign or malignant neoplasms) or hyperparathyroidism is increased among people exposed to radioactive iodine from Hanford.
- 3) The Hanford Health Information Network (HHIN), an information and referral source created in 1991 to inform health care providers and the public about the known and potential health effects of radiation released from Hanford. The Network is a collaboration of the state health agencies in Oregon, Washington and Idaho, and nine Indian Nations.

This issue of the *CD Summary* provides an overview of Hanford-related health issues. It also includes a list of services available to health care providers and citizens through the Hanford Health Information Network.

AIR RELEASES

Most of Hanford's air releases came from the chemical process used to separate plutonium and uranium from fuel rods (see table). An estimated 739,000 curies (Ci) of radioactive iodine-131 (¹³¹I) were released from Hanford — primarily between Dec. 1944 and Dec. 1947. (By comparison, the 1979 accident at Three Mile Island released 15 Ci of ¹³¹I.) Avail-

Milk from cows fed on fresh pasture is estimated to be the major exposure pathway for ¹³¹I. Infants and young children received the highest doses because of relatively greater milk consumption, smaller thyroids and greater thyroid uptake of ¹³¹I than adults.

COLUMBIA RIVER RELEASES

Radioisotopes were released (see table) into the Columbia River via water used to cool the plutonium production reactors at Hanford. Releases to the river were greatest from 1955 to 1965, when up to eight reactors were operating at high power levels that required large amounts of water to cool the reactor cores.

Isotope	Release	Route of Exposure	Target Organs	Half-life
Iodine-131	739,000 Ci	ingestion	thyroid	8 d
Ruthenium-103	1,160 Ci	external, inhalation	whole body, lungs	39.4 d
Ruthenium-106	388 Ci	inhalation, ingestion	lungs, GI tract	368 d
Strontium-90	64.3 Ci	ingestion	bone surfaces, bone marrow	28.8 y
Plutonium-239	1.78 Ci	inhalation	lungs, bone surfaces	24,100 y
Cerium-144	3,770 Ci	inhalation, ingestion	lungs, GI tract	284 d

able evidence indicates that ¹³¹I accounted for ~98% of the dose received by most individuals from the air releases.

Factors determining an individual's dose—the amount of energy absorbed by the body—from airborne radiation include:

- distance and direction a person lived from Hanford,
- years of residence,
- age at exposure,
- quantity and source of milk, fresh fruits and leafy vegetables consumed.

An individual's dose from the river depended primarily on the amount of non-migratory fish (such as trout and whitefish) eaten, where and when the fish were caught, and the amount of contaminated river water consumed. Recreational or occupational use of the river, eating shellfish harvested near the mouth of the Columbia and exposure to water from irrigation also contributed to an individual's dose.

Isotope	Release	Route of Exposure	Target Organs	Half-life
Phosphorus-32	229,000 Ci	ingestion	bone marrow	14.3 d
Zinc-65	491,000 Ci	ingestion	whole body	245 d
Arsenic-76	2,520,000 Ci	ingestion	GI tract, stomach (infants)	26.3 h
Sodium-24	12,600,000 Ci	ingestion	stomach	15 h
Neptunium-239	6,310,000 Ci	ingestion	GI tract	2.4 d

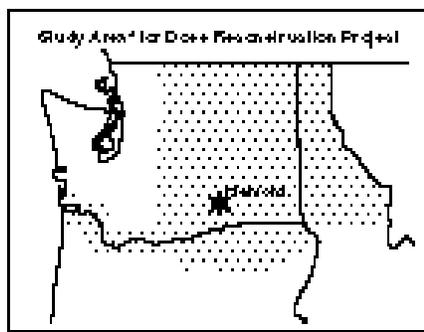
RADIATION HEALTH EFFECTS

Radiation health scientists generally believe that any dose of radiation carries with it an increased risk of some adverse health effect. Most research on radiation health effects has focused on effects of short-term, high-dose radiation exposures. Many researchers speculate that low-dose exposures will have proportionately smaller effects. However, some researchers suggest that chronic exposures to low-dose radiation — like most exposures from Hanford — may be relatively more harmful than high-dose exposures.

The potential health effects of Hanford's radiation releases deserve particular attention because of the duration and extent of exposures. No other situation has yet been studied in which so many people were exposed to low-dose radiation continuously over a number of years. Also, adults who lived in the area as infants may have been exposed to significant doses of radiation, but may be unaware of their past exposures.

It can be extremely difficult to confirm or rule out a causal link between historical exposures and later illness. Health care providers should be aware that many people who lived in the exposed area report what they believe are unusual patterns of disease occurrence, including clusters of cases of thyroid disease, cancers, autoimmune disease, genetic effects, and birth defects. Two examples illustrate the kinds of concerns many exposed individuals have.

A resident of Coeur d'Alene, Idaho, during the years of peak air releases, noticed an apparent high rate of premature death among her high school classmates, and in 1987 conducted a health survey.



Forty-percent of the graduates from 1951 to 1954 responded. Between 48% and 52% of females from each class reported some form of thyroid dysfunction. In addition, 1 of every 2.5 to 3.5 women reported having one or more miscarriages.

A woman who lived in Pasco, Washington, from age four until her mid-twenties (at high risk of exposure from both the air and Columbia River pathways) reports that she and her sister both experienced multiple miscarriages; both have hypothyroidism. Her two children were born with cardiac abnormalities. At a recent class reunion, she met with six high school classmates, five of whom are hypothyroid. When the spouses were included (five of the seven women were married), eight of the 12 former residents are hypothyroid.

Many people who lived in the exposed area say they would like their health care providers to be aware of these past exposures and be understanding of the uncertainty these exposures may cause. They also say they would like their providers to offer an open and supportive environment in which to discuss these health concerns.

*Fortunately, the Montana and Canadian borders proved impermeable to airborne drift, so these areas could be excluded from study.

HOW HHIN CAN HELP

The Hanford Health Information Network can provide a variety of informational and referral resources to health care providers and their clients regarding past radiation releases at Hanford, including:

- A monograph self-study course developed in collaboration with the University of Washington School of Medicine about the potential health effects of radioactive materials released from Hanford.
- Reprints of scientific and medical studies about radiation health effects.
- Introductory publications about past Hanford radiation releases and possible health effects.
- Referral resources for disease-specific information and organizations.
- Dose estimates for representative people with "typical" eating habits living in several locations throughout the exposed area. (Individual dose estimates may be available by late 1996).
- Screening guidelines developed by the Hanford Thyroid Disease Study for persons concerned about thyroid disease.

The Network welcomes the collaboration of health professionals who may wish to refer patients to the project's information line or to make publications available in their offices. Oregon's toll-free number is 800/248-4446; the number in Washington is 800/522-4446.

RECOMMENDED READING

1. Elaine R, et al. Thyroid cancer after exposures to external radiation: a pooled analysis of seven studies. *Radiation Research* 1995;141:259-277.
2. Shigenobu N, et al. Thyroid diseases among atomic bomb survivors in Nagasaki. *JAMA* 1994;272: 364-370.
3. Upton AC. Health effects of low-level ionizing radiation. *Ann. Rev. Public Health.* 1992;13:127-150.
4. Shleien B, et al., Epidemiologic studies of cancer in populations near nuclear facilities. *Health Physics* 1991;61:699-713.