

**"ESTIMATED EXPOSURES AND THYROID DOSES RECEIVED BY THE
AMERICAN PEOPLE FROM IODINE-131 IN FALLOUT FOLLOWING THE
NEVADA ATMOSPHERIC NUCLEAR BOMB TESTS"**

Statement of

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before the

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Good morning Senator Specter, Senator Harkin, and Members of the Subcommittee. I am Richard Klausner, Director of the National Cancer Institute (NCI), and today I am presenting to you, for the first time, the completed NCI report estimating thyroid doses of Iodine-131 (I-131) received by Americans as a result of atmospheric nuclear bomb tests conducted at the Nevada Test Site. This study was conducted in response to legislation enacted by the 97th Congress of the United States.

PUBLIC LAW

Public Law 97-414, in part, directed the Secretary of the Department of Health and Human Services (DHHS) to conduct scientific research and prepare analyses necessary to develop valid and credible methods to estimate the thyroid doses of I-131 that are received by individuals from nuclear bomb fallout, and to develop valid and credible assessments of the exposure to I-131 that the American people received from the Nevada atmospheric nuclear bomb test. The magnitude, complexity and difficulty of such research is without precedent and the fact that such a study was completed is testimony to the expertise and commitment of a large number of government and non-government scientists, and particularly of two NCI researchers--Dr. Bruce Wachholz and Dr. Andre Bouville. The study was designed and carried out with the help of an Advisory Committee with representation from the fields relevant to radiation science. This study was not designed to evaluate the health effects of I-131 exposure, so such risk estimates are not part of this study.

I-131 RELEASE AND DEPOSITION

Ninety nuclear tests released almost 99 percent of the total I-131 entering the atmosphere from the bomb tests conducted at the NTS. These 90 tests released about 150 million curies of I-131, mainly in the years 1952, 1953, 1955, and 1957. Some radio-iodine was deposited everywhere in the U.S., with the highest deposits immediately downwind of the

NTS. The lowest deposits were on the west coast, upwind of the NTS. In the eastern part of the country, most of the deposited I-131 was associated with rain, while in the more arid west, dry deposition (where particles settle on the ground) prevailed. Because I-131 has an 8-day half-life, exposure to the released I-131 occurred primarily during the first two months following a test.

DOSE RECONSTRUCTION

A major challenge of this study was the attempt, three to four decades after the events, to retrospectively assess the exposure of persons throughout the country. For most tests, however, it was possible to estimate the amounts of radioactivity deposited on the ground in fallout from the measurements of radioactive particles collected on sticky surfaces (i.e., gummed film). These collection units were geographically dispersed around the United States, and the collections were made systematically as part of an environmental monitoring program. These original data were re-analyzed in order to estimate the I-131 component in the fallout. Beginning with such measurements, the study used mathematical modeling of these and other relevant measurable data to estimate the levels of thyroid exposure in approximately 160 million Americans in the 48 contiguous states of the country during the test period. In the absence of environmental radiation measurements during some tests, meteorological dispersion models were developed to calculate the amount of fallout deposits.

The assessments of thyroid exposure have two components: deposition of I-131 and the exposure of persons. First, mathematical models were developed to estimate the amount of I-131 deposited in each of 3094 counties (and sub-counties mapped in a few areas) in the contiguous 48 states. This involved re-analysis of data from monitoring stations in operation across the U.S. during the testing program and the use of a meteorological model. This information, coupled with precipitation data for each county during the time the fallout clouds were over the U.S., permitted estimates of I-131 deposition. The dispersion of the cloud was tracked at four different altitudes in the days after each test to determine distribution of radioactive clouds. This component of the study was carried out in cooperation with experts from the Department of Energy (DoE) and from the National Oceanic and Atmospheric Administration (NOAA).

Second, thyroid exposure to the U.S. population resulting from this fallout was assessed. It is well known that consumption of milk from cows grazing on contaminated pastures is the principal route by which I-131 is incorporated into human tissues, especially for children. Most of the exposure to environmental I-131 resulted from the consumption of this contaminated milk and, for some individuals, from the consumption of fresh goats' milk. This component of the study, which was carried out with the help of experts from the U.S. Department of Agriculture (USDA), involved the compilation of extensive and detailed information regarding pasture consumption and grazing patterns, the production of milk by cows, and milk distribution and consumption patterns throughout the country. These data were used in mathematical models to estimate the transfer of I-131 from deposition on the ground to the intake by humans of I-131 resulting from the consumption of contaminated cows' milk of various origins. In addition, other exposure

pathways such as the consumption of contaminated goats' milk, eggs, leafy vegetables, and cottage cheese were considered as well as the inhalation of contaminated air.

Finally, thyroid dose was estimated on the basis of the exposures that were assessed for each nuclear test and each county of the contiguous United States. Thyroid doses from intake of I-131 vary substantially as a function of age and depend mainly on the size of an individual's thyroid gland and on the amount of fresh cows' milk an individual consumed. For that reason, thyroid doses were estimated for 13 age categories, including four in-utero ages, four for infants under one year of age, four for children under age 20, and adults. The thyroid doses to adults were estimated separately for males and for females. Also, because the origins of milk and the level of consumption vary substantially from one individual to another, thyroid doses have been estimated for people drinking average amounts of fresh cows' milk with average I-131 contamination levels from commercial sources; for people drinking large amounts of cows' milk with above-average I-131 contamination levels from commercial sources; for people drinking milk from backyard cows; and for people drinking no cows' milk but consuming other foodstuffs contaminated with I-131.

The calculation of these thyroid doses resulted in the production of about 100,000 pages of data and analyses that show--by county, for each weapons test, each series of tests, and the entire testing period-- average levels of predicted exposure for the 13 age groups and for both genders, and for four milk consumption patterns. In addition, detailed maps have been prepared, showing the deposition pattern of I-131 on the ground and the average thyroid doses for the population of each county of the contiguous United States after each weapons test and series of tests. The overall average thyroid dose to the approximately 160 million people in the country during the 1950s is estimated to have been about 2 rad. ARad means Aradiation absorbed dose. It is a physical unit of energy deposition. To put this amount of exposure into perspective, routine medical use of x-rays during the 1940s and 1950s exposed children to anywhere from 5 to several hundred rad, and all persons receive doses from natural background radiation of about 0.1 rad per year.

Because the study relied on a limited number of measurements and was based essentially on mathematical models, the uncertainties associated with the thyroid dose estimates are fairly large, usually a factor of three or more for averages pertaining to population groups; for individuals the uncertainties might be greater. However, a comparison of the results obtained in this study with those derived from the few I-131 measurements that were carried out in the 1950s, either in the urine or in the thyroids of people, or in cattle thyroids, show a reasonably good agreement.

PUBLIC AWARENESS

It is important to note the context in which this study was carried out. What was known publicly about fallout? During the late 1950s and early 1960s a series of Congressional hearings were held and the published scientific literature was introduced into the public record. The preliminary results of the NCI study are remarkably consistent with these early reports. For example, the range of estimated I-131 exposure for children had

previously been identified in the 1960s ranging from 4 to 120 rad; the NCI study places ranges between 0 and 100 rad. The results obtained in this study are also consistent with those obtained by the DoE and the University of Utah for populations living in states close to the Nevada Test Site.

As the preliminary findings of the NCI study took form in the early 1990s, NCI staff made a decision to prepare the data and formulae to be useful, accessible, and user friendly. An interactive format, now available on the World Wide Web, allows an individual to estimate his or her own exposure. By designating a state and county, and date of birth, users will receive a table of the estimated doses to the thyroid after each nuclear test. Dosages are also calculated for four different milk-drinking scenarios.

INTERIM REPORTS

During the time period of data collection, calculation, and analysis, the NCI drafted status reports in 1984, 1986, and 1991 for transmittal to the Congress by the Secretary, HHS. The methodologies used in the study have been presented at scientific meetings since the project's inception in 1983. Meetings of the I-131 Advisory Committee, which was chartered in 1984 with experts in all relevant fields of science to assist NCI staff in carrying out this study, were open to the public. It served until 1993 as a place where presentations and discussions of the latest findings of the study and more broadly in the scientific arena could be aired. Updates were presented frequently to the NCI's Board of Scientific Counselors and in open meetings. Papers about the study have been presented at national and international scientific meetings since 1987. Since 1990, preliminary results have been published in the scientific literature.

THYROID CANCER & RADIOACTIVITY

Thyroid cancer is uncommon, accounting for just one percent of all cancers in this country. Each year about 16,000 cases are diagnosed in the U.S., with an estimated 1,230 deaths. Thyroid cancer is very curable, with the five-year survival rate at 95 percent. This type of cancer occurs more often in women than in men, and is at ages as young as 5. In men, incidence rises gradually with increasing age, leveling off after about age 70, whereas in women the increase is steeper, leveling off after age 30 or 35. Between 5 and 10 percent of cases eventually result in death, usually after age 50 and usually attributable to the relatively rare anaplastic and medullary forms of the disease.

Scientists do not know what causes most cases of thyroid cancer. One known risk factor is exposure to external radiation during childhood. Commonly, during the 1940s and 1950s, children received x-ray treatments to the head and neck for noncancerous conditions such as enlarged tonsils, enlarged thymus gland, acne, and ringworm of the scalp, and as a result these individuals have a higher-than-average risk of developing thyroid cancer many years later. A compilation of multiple studies has demonstrated that exposure during childhood to 100 rads of external radiation results in a 7-8 fold increased risk of thyroid cancer. The vast majority of risk is seen for children who are exposed below the age of 10.

While it is very likely that exposure to I-131 also increases the risk of thyroid cancer, there is considerable uncertainty as to the relative carcinogenicity of I-131 fallout exposure compared to external radiation. Throughout the course of the fallout study being released today, the NCI engaged in and funded studies attempting to evaluate the risk of thyroid cancer from I-131, in order to fulfill the third component of the legislation, which was to determine the risk of thyroid cancer associated with I-131 exposure.

Thus far, studies of exposure to I-131 for medical purposes or from fallout in areas downwind from the site of atomic bomb tests during the 1950s have not produced conclusive evidence that such exposure to I-131 is linked to cancer. In 1992, the University of Utah reported a statistically significant dose-response relationship between exposure to radioiodines and occurrence of thyroid neoplasms (combined benign and cancerous tumors) in a group of nearly 2500 children in Utah, Nevada and Arizona who had been examined in the 1960s and again in the 1980s. However, while the correlation between the I-131 radiation dose and thyroid cancers alone was suggestive, it was not statistically significant and therefore could have been due to chance.

The relationship between I-131 exposure and thyroid cancer continues to be studied. In 1985, NCI collaborated with Swedish scientists on a study of diagnostic I-131 received by 35,000 patients who received an average dose of 100 rad to the thyroid. At this mean dose an excess risk of thyroid cancer was seen only among persons referred for examination because a thyroid tumor was suspected. The study included 2,408 persons exposed before age 20, and 314 children aged 10 and under. Among persons between 15-19 years of age, two cases of thyroid cancer were observed compared to 1.5 cases expected. No cases were seen in children under age 15.

It is perhaps too early to know, but it seems likely from preliminary information that thyroid cancer increased in those populations of Belarus, Ukraine, and Russia most affected by the Chernobyl accident, and that I-131 exposure is the probable cause. Assuming the eventual results are positive, the unresolved question will be how the risk from I-131 exposure compares to the risk associated with similar doses from x-rays. The Chernobyl nuclear accident provides a tragic opportunity to obtain valuable information needed to further develop these risk estimates. NCI staff recognized the value of this opportunity to address that component of PL 97-414 that instructs the government to carry out research to make assessments of the risk of thyroid cancer from I-131. Our studies, supported jointly by the Department of Energy and the Nuclear Regulatory Commission, include about 15,000 children in Belarus and 30,000-40,000 in Ukraine, a number of whom received doses in excess of 1,000 rad to the thyroid. The I-131 Advisory Committee as well as the NCI believed that it was in the interests of the U.S., as well as the world community, to invest the time and effort needed over the past several years to accomplish the complex negotiations required to undertake cooperative studies of thyroid disease with scientists in Belarus and Ukraine.

NCI is currently analyzing thyroid cancer incidence in our SEER (Surveillance, Epidemiology and End Results) Program and in nationwide mortality data. Preliminary analyses of these data across age groups have been done and we do not discern any

obvious correlation with areas of high I-131 exposure. However, these analyses do not rule out the possibility that thyroid cancer risk has been elevated in exposed individuals and we are continuing to evaluate these data to look for more complicated patterns. We also are investigating the possibilities of conducting other studies, and expect that further discussions along these lines will be undertaken by the Institute of Medicine.

WHAT'S NEXT?

Communication Plan

Since I became aware of this study last Spring, we moved as quickly as possible to format and prepare the entire study for release in a form that was accessible and understandable. The goal of the NCI has been and continues to be to fully inform the public as to the results of research while adhering to quality control procedures to assure that information released is of high scientific quality and credibility.

We have established an infrastructure to provide technical assistance to health care providers and health departments in interpreting the report (see Help Line below), and to respond to inquiries from patients and individuals exposed to radiation fallout, and to the media. We are working with the American Thyroid Association to provide interim education resources to physicians, patients and the public. We are helping state health departments interpret the report and respond to inquiries at the state and county level. We have announced through the media the availability today of the full report. The Cancer Information Service (CIS) has interim guidance and background information for all target audiences about the incidence, mortality and survival rates for thyroid cancer, and statistical information about trends in mortality, incidence, and survival in high-exposure areas.

Dissemination Plan

NCI has announced today, through media channels, Congressional channels, and through state health departments:

the availability of the I-131 report, including appendices and data, on the world wide web. The information is available at the NCI web site (<http://www.nci.nih.gov>) and at its public, patient and media sub-page (<http://rex.nci.nih.gov>). At either site, click on "What's New"

the availability of a technical assistance helpline (1-800-273-7092) for health officers and health professionals. This telephone number, to be operational beginning October 1, is 1-800-273-7092.

interim guidance with the American Thyroid Association for health professionals on helping individuals concerned about fallout exposure.

the availability of background information on thyroid cancer for members of the public and cancer patients from the Cancer Information Service at 1-800-4-CANCER (1-800-422-6237).

that the study's narrative report was express-mailed to state health departments and other government agencies and select congressional members.

Help Line

NCI has established a toll-free technical assistance helpline (1-800-273-7092) to assist professionals in interpreting the report. We envision that support will be provided to health professionals such as public health officials, researchers, radiation epidemiologists, advocacy and special interest groups, and physicians and other health care providers. Voice mail is available for after-hours calls. Staff assisting with answering calls will have sufficient educational background and knowledge to effectively triage the calls and respond with credibility. We have also established a parallel system and procedures for responding to e-mail requests for technical assistance. Health officers and health professionals may send e-mail requests to CISOCC@nih.gov. Public and patient inquiries and e-mail will continue to be handled by the CIS. NCI staff will handle Congressional and press inquiries.

Institute of Medicine

An NCI contract with the National Academy of Sciences-Institute of Medicine (IOM) went into effect September 30, 1997. The IOM will produce two substantive reports. The first, which is to be published in April 1998, will assess the soundness of the I-131 study's dose reconstruction, provide a preliminary assessment of the public health implications, and provide information to enable DHHS to educate and inform members of the public and the medical profession. The second report, to be published in June 1998, will develop recommendations for how we should address the public health implications (including intervention, surveillance, education and information strategies and clinical practice guidelines), and develop recommendations for research strategies that could refine risk estimates and reduce uncertainty of the effect of exposures.

There have been preliminary discussions within the Administration about the formation of a workgroup to look at broader issues. DHHS will convene a meeting before the end of the year to begin the process.

Until the IOM completes its report, we are suggesting that concerned individuals consult with their physician during their next visit. This recommendation is consistent with the position of the American Thyroid Association, which says that individuals who believe they may have been exposed to significant amounts of fallout and feel they are at particular risk might wish to see their physician.

CLOSING

The NCI appreciates the great interest and concern that you and the public have that high quality and fully disclosed information be provided about nuclear fallout. This is especially true in the context of the legacy of the cold war in which such information was too often not provided or hidden. We hope that this study will contribute to our knowledge about the release and distribution of I-131 and how individual thyroid exposures can be assessed.

Thank you for this opportunity to describe this NCI study and to clarify its limitations. I would be pleased to respond to questions.