MEDICAL INFORMATION SHEETS

RADIATION THERAPY FOR ACNE
RADIATION THERAPY FOR ASTHMA
BIRTHMARKS AND RADIATION
USE OF X-RAYS FOR BURSITIS
FLUOROSCOPY FOR SHOE-FITTING
RADIOACTIVE IODINE FOR DIAGNOSTIC AND THERAPEUTIC USES
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THIOURACILS IN MEDICINE
IRRADIATION OF THE THYMUS GLAND
X-RAY THERAPY FOR WARTS
Synopsis:

Radiation, in the form of roentgen rays (now called x-rays), was used in the United States for the treatment of acne as early as 1902. Acne treatment by radiation continued until almost 1960.

What causes acne? Acne is the result of overactivity in the sebaceous glands (oil-producing glands located at the base of hair follicles) followed by an inflammation of the hair follicles. Irradiation of these glands reduced their secretions and the inflammatory process. The beneficial results obtained from radiation therapy were attributed to shrinkage of the sebaceous glands and the reduction in oils that were produced. A comparison of acne treatments by vaccine, hormonal therapy, and split-doses of radiation showed that radiation produced the most favorable results. However, excess radiation could also produce skin burns, and physicians became increasingly concerned about potential side effects of radiation.

The treatment of acne with x-rays was discontinued over time in favor of less toxic and more effective drug therapy, hygiene (facial washing), and dietary restrictions.

References:


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By the Office of Human Radiation Experiments
of the Department of Energy
Synopsis:

The therapeutic effect of radiation in the management of allergic diseases, especially asthma, was investigated by medical doctors in 1906. Probably the first systematic treatment of asthma by x-rays in this country was practiced at the Mayo Clinic in 1931. Thousands of children and adults with asthma were treated with radiation from x-rays or radium during the 1930s and 1940s.

Why was radiation used to treat asthma? Hypertrophied (swollen) and infected lymphoid tissues (adenoids) were frequently found in children suffering from bronchial asthma. Such asthmatic children were usually sensitive to one or more airborne allergens as well. The infected tissue served as a focus when the children were exposed to bacteria (colds) and often contributed to the asthmatic episode. Radiation therapy was effective in reducing tissue mass, and therefore was thought to be a valuable and effective treatment in selected cases of asthma in children in whom some or all attacks were precipitated by respiratory infections.

Children with asthma of over two years duration were treated with x-ray or radium irradiation of the nasopharynx (nose and throat). Radiation treatments were typically administered in a series of three irradiations lasting six to ten minutes every few weeks. If a second series was required, it was generally given six to twenty-four months later. Since there was no marked difference in results between the patients treated with radium and those treated with x-rays, a combination of both was often used. Improvement for periods from six months to four years was noted in 80 percent of those treated with no particular tendency to recurrence.

The use of radiation therapy for the treatment of asthma was discontinued by about 1960 in favor of less toxic and more effective drug therapy.

References:


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Synopsis:

The term 'birthmarks' or nevi encompasses a wide variety of colored or non-colored malformations of the skin. A family of birthmarks ranging in color from pink to deep purple are related to the capillary system. This group of birthmarks includes the common portwine and strawberry stain marks. During the 1940s a variety of treatments was employed to eradicate or decrease the size of these marks. Radium treatment was commonly and successfully used in the case of strawberry birthmarks and the deeper type associated with this group. However, radium treatment was found to have little effect on the portwine stain type of birthmark. The success of this therapy was found to be directly related to age. Therefore, radiation therapy was most commonly used in younger patients. Radon seed implantation was recommended as an alternative treatment for both strawberry marks and the deeper marks. Seeds had the advantage of reduced medical follow-up. Birthmarks other than those of this family were found to be relatively insensitive to radiation and were most frequently treated by surgery, cauterizing with electricity, or freezing with carbon dioxide.

Today, radiation has been replaced with newer methods for treating birthmarks. The laser has replaced radiation as a more safe and effective therapy.

References:


Synopsis:

The bursa is a sac-like cavity filled with fluid at locations in the body where friction occurs, such as where tendons or muscles pass over bones of the shoulder, elbow, knee, and heel. The bursa aids movement and prevents friction between the moving parts. Bursitis is an inflammation of the bursa. The causes of bursitis are thought to be trauma, overuse, infection, arthritis, or gout. Bursitis was treated with rest, splints, heat, physical therapy and surgery. Local injections of anesthetics such as novocain into the joint were also used to treat bursitis.

X-ray therapy was used by physicians to treat bursitis during the 1940s and 1950s. It was considered to be a common and acceptable practice of that era. Radiation reduced tissue mass, which made bursitis less painful. The use of x-ray therapy for the treatment of bursitis was discontinued by about 1960 in favor of less-toxic and more-effective drug therapy (anti-inflammatory agents, steroids, pain medication), aspiration of the joint, surgery, and other conservative measures (such as rest, splinting, and exercise).

References:


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SYNOPSIS:

Fluoroscopy was a common practice during the 1940s and 1950s in many shoe stores and department stores (particularly those specializing in children's shoes) for measuring foot size and supplementing other usual methods of shoe-fitting. So-called "x-ray shoe fitters" were considered to be a modern and harmless application of x-ray technology. These devices consisted of an x-ray tube housed in a case lined with lead or steel and containing a fluorescent screen. The unit was equipped with an opening for the customer's feet and three viewing openings through which the customer, clerk, and one other person could observe the screen. A push-button automatic timer, which could be set for any predetermined time, was included on most installations. In actual use, exposure times were found to vary from 5 to 45 seconds, although 25 seconds appeared to be the most popular setting. Repeated exposures could be made by releasing and pushing the button. Later models were equipped with three separate switches providing three different intensities -- one for men, one for women, and one for children.

Excessive use of fluoroscopy devices, however, was found, in some cases, to cause skin burns and abnormal foot growth in children. A series of studies were begun in 1949 to determine radiation exposures received by customers, clerks, and other persons from the x-ray shoe-fitting units. Radiation doses to feet, leakage through the walls of the cabinet, and scattering from the opening in which the customer placed his feet were measured. Recommendations were made to add more lead shielding, to educate store employees about the potential harmful effects of radiation, and to minimize use of fluoroscopy devices and viewing times to minimize the potential for radiation injury to customers and employees.

The use of the shoe-fitting fluoroscopes was mostly discontinued by about 1960, because it was recognized that such devices were not actually needed to properly fit people with shoes, and that the potential risks of radiation exposure exceeded the benefits.

REFERENCES:


Williams, Charles R. "Radiation Exposures from the Use of Shoe-Fitting Fluoroscopes." New England Journal of Medicine, September 1, 1949, pp. 333-335.

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Prepared September, 1994
By the Office of Human Radiation Experiments
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Synopsis:

Nuclear medicine has found its earliest application in the study, diagnosis, and treatment of the thyroid gland and thyroid disorders. The affinity of the thyroid for iodine permits the use of radioisotopes as both a diagnostic tool and as a therapeutic agent. Radioactive iodine (I-131 and other isotopes of iodine) has been used in medical applications since the early 1940s, when it became available in commercial quantities. By the mid 1950s, nuclear medicine procedures using radioiodine had gained wide acceptance within the medical community.

Radioactive iodine is used to diagnose hyperthyroidism, such as Toxic Goiter, Graves' Disease, or Basedow's Disease and to evaluate problems after the surgical removal of the thyroid. I-131 is used also in the diagnosis of cancer of the thyroid.

As a therapy radioactive iodine has proven to be the most effect artificial radioisotope. Initially reported as a treatment for hyperthyroidism in 1942, I-131 remains a principle therapy today. There has been no proven increase in tumors, leukemia, or cancer with this therapy in young patients. However, the treatment is avoided with pregnant or breast-feeding women. Radioactive iodine therapy avoids the potential side effects associated with chemical medications.

Two approaches have been used with radioactive iodine as treatment for thyroid cancers. I-131 may be used alone to provide concentrated internal radiation to the cancer without serious damage to surrounding tissues posed by external radiation such as radium or x-ray treatment. Radioactive iodine may be also used in conjunction with surgery. In this case total or partial removal of the thyroid is routinely followed by treatment with radioactive iodine.

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Synopsis:

Radioactive phosphorus (P-32) was first produced in cyclotron at Berkeley in 1936. Medical applications were found for P-32 in the diagnosis and treatment of a wide variety of disorders, including acute and chronic leukemia, Hodgkin's disease, polycythemia vera, eye tumors, and various other forms of cancer. It was also used to reduce the pain of bone cancer and bone metastases from other forms of cancer. Radiophosphorus was administered either orally or intravenously in both diagnostic and therapeutic amounts.

The most successful medical application of P-32 was the treatment of polycythemia vera, a condition in which there is an increase above the normal level of red cells in the blood. Symptoms of this disorder are weakness, headache, light-headedness, visual disturbances, fatigue, and shortness of breath. Since the cause of polycythemia vera is not well established, treatment seeks to reduce the severity of symptoms rather than eliminate the disease entirely. The treatment is well tolerated by most patients and requires little follow-up once the disease is controlled. However, P-32 therapy is also associated with an increased incidence of acute leukemic transformation. For this reason P-32 treatment has generally been discontinued in favor of other standard chemotherapy regimens. An alternative, radioactive strontium-89-chloride, was recently approved as an agent for reduction of pain from bone cancer.

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*Prepared September, 1994*

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Synopsis:

Ringworm is a fungus infection affecting the skin on various parts of the body. The type of ringworm (tinea capitis) that affects the head and scalp is particularly difficult to cure and can become epidemic in younger children. X-ray treatment for ringworm was first advocated in Europe in 1904 and the procedure was standardized in 1907. X-ray treatment was improved during the early part of the century and became a generally accepted practice among dermatologists during the ringworm epidemic of the 1940s and 1950s, both in the United States and in England. The procedure was considered to be painless and harmless, and was therefore recommended for unrestricted use. As late as 1956, x-ray treatment for hair removal was still practiced as a method to treat ringworm, particularly in the most stubborn cases. New oral and topical anti-fungal ointments have replaced X-rays and have reduced treatment for ringworm to approximately two to four weeks.

References:


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By the Office of Human Radiation Experiments
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Synopsis:

Radioactive materials (radioisotopes) have been used in medicine for the diagnosis and treatment of cancer and various other medical conditions since their discovery in 1895. All radioactive isotopes emit rays (or energy) which give them their special value to medicine. These rays are generally used to destroy or alter the function of cells in an effort to eliminate the medical condition. Physicians use radioactive isotopes with caution and carefully select the isotope used according to the type of energy it emits, its decay rate and radioactive lifetime, natural metabolism in the body, and other useful chemical properties.

Radium was used primarily in the treatment of tonsillitis, chronic ear infections, birthmarks, acne, thymus conditions, ringworm, warts, and various cancers. Radium needles were used to treat oral tumors. Radium has been generally discontinued in favor of other approaches.

Radioactive iodine is used in the treatment of overactive thyroid glands, thyroid cancers, and heart disease (chest pain and congestive heart failure). Radioactive iodine is also used to identify the sites of new cancers that have spread from the thyroid gland. It is still one of the most widely used isotopes in modern nuclear medicine.

Radioactive phosphorus was used to treat polycythemia vera (the excessive production of red blood cells), leukemia, Hodgkin's disease, eye tumors, and various other cancers, and to reduce pain associated with bone cancer.

Radioactive cobalt has been used to treat various cancers (such as bladder, breast, cervix, lung, mouth, throat) as an external source of gamma rays.

Other radioactive isotopes used in the diagnosis and treatment of disease include those of the elements: iron, copper, zinc, chromium, carbon, potassium, sodium, nitrogen, beryllium, magnesium, arsenic, sulfur, yttrium, calcium, technetium, rhenium, strontium, and gold.

Care is taken in the use of radioisotopes to maximize radiation dose to cancer cells while minimizing dose to normal tissues.

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*Prepared September, 1994*  
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*of the Department of Energy*
Synopsis:

Radium was first used as a medical therapeutic agent in North America in about 1904. Dissolved radium in water was thought to have some medicinal quality. Gamma radiation from radium sources was used both internally and externally, primarily for treatment of cancers such as those of the brain, larynx, esophagus, stomach, rectum, breast, bladder, testicles, prostate, cervix, ovary, uterus, and also for diffuse cancers such as Hodgkin's disease, lymphosarcoma, and leukemia. Radiation from radium was also used to treat other non-malignant medical conditions and growths, such as goiters, enlarged thymus gland, thyroid disorders, nasal polyps, eye infections, and certain bone disorders.

Radium tubes were used extensively during the 1950s and 1960s for the treatment of chronic tonsillitis and enlarged adenoids, and for reduction of lymphoid tissue following tonsillectomy and/or adenoidectomy, reduction of thymus gland (to prevent crib death), acute and chronic ear infections (otitis media), ear trauma (aerotitis media) suffered by World War II pilots and Navy divers, birthmarks, acne, ringworm of the scalp, and various hearing disorders (mild tone deafness in children).

The anticipated effect of radium therapy was a slow reduction in the mass of tissue, so that the tissue flattened and became thinner. Tissue folds, pits, or crevices opened and shrank after exposure to radiation. This made radium the treatment of choice by some physicians for conditions where inflamed or swollen tissues were problematic. Radiation therapy was generally given in a series of three or four treatments over two weeks, and was repeated, if necessary, after six months.

Since gamma radiation originated from external radium sources, the skin usually received the highest dose. The use of radium rods, needles, and seeds avoided skin exposure, and allowed the radiation to be applied internally, and then be completely removed from the patient. However, side effects such as tissue scaring and increased incidence of thyroid cancer were associated with radium therapy. Therefore, the use of radium as a therapeutic agent was discontinued before 1960 in favor of less toxic and more effective treatments, such as antibiotics and surgery.

References:


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Synopsis:

During the 1940s and 1950s, radiation was considered an acceptable therapy for relief of sinus blockages and infections. X-rays from cathode-ray tubes and gamma radiation from radium tubes were used as radiation sources. The most notable effect of roentgen (x-ray) therapy for sinus problems was the relief of pain and headache. This relief of pain was often accompanied by a noticeable increase in sinus discharge, so it was thought that the effect of x-ray therapy on the sinuses was a reduction in the swelling of the tissues and release of mucous buildup. Roentgen therapy was generally not used as the sole therapeutic agent in cases of acute sinusitis but as an adjunct therapy, especially in regard to relief of symptoms. Thus, it was believed that symptomatic relief was evidence of the effectiveness of this type of treatment.

Severe side-effects, such as scarring and the increased incidence of head and neck tumors were eventually associated with radiation therapy for sinus conditions. The treatment of sinus conditions with x-rays was discontinued by 1960 in favor of less toxic and more effective drugs, medications, and surgery.

References:


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Synopsis:

Thiouracil, medically known as "Deracil," and similar compounds have been used to treat thyroid disorders since the early 1940s. This class of compounds provides a non-radioactive alternative therapy to radioactive iodine or surgical removal of the thyroid in cases of thyroid cancer.

Hyperthyroidism is a family of disorders including Graves' disease, Basedow's disease, and Plummer disease, and is characterized by an excess production of thyroid hormones. Common signs of hyperthyroidism are goiter, tremor, and moist skin. The most frequent symptoms are nervousness, increased activity, increased sweating, increased sensitivity to heat, fatigue, increased appetite, and weight loss. The most common treatment for hyperthyroidism is radioactive iodine. However, radioactive iodine is not advised for pregnant women or breast-feeding mothers. In these cases, thiouracils are the medication of choice to return the thyroid hormone levels to normal. Surgical removal of the thyroid may be avoided by stabilizing and maintaining the patient on thiouracil medication and synthetic thyroid hormone.

The first successful reports of thiouracil appeared in the medical literature in 1941. Thiouracil was replaced by less toxic medications having similar chemical structures. Today the compound propylthiouracil is used with minimal adverse effects. Potential side effects are nausea and loss of taste. Thiouracils have also been used to treat angina pectoris (a severe, constricting pain in the chest usually associated with coronary disease) and congestive heart failure.

References:


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of the Department of Energy
Synopsis:

The exact purpose and function of the thymus gland was relatively unknown in the 1940s. However, a number of experienced medical doctors thought that an enlarged thymus, particularly in newborns and young children, caused stridor (noisy respiration caused by obstruction of the airway), shortness of breath, suffocating spells, cyanosis (bluish coloration of the skin due to insufficient oxygen in the blood), and crib death. In many cases, physicians treated the enlarged thymus glands with x-rays or gamma rays from radium sources in an effort to shrink the gland and prevent blockage of the airway.

By 1949, it was believed that irradiation of the thymus gland was justified only after a careful search had eliminated other possible causes for the symptoms. During the mid-1950s, the usefulness of thymus reduction by radiation was questioned and is no longer practiced. In addition, an increased incidence of thyroid cancer in adults has been associated with their irradiation of the thymus gland as children.

References:


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Synopsis:

Warts are a commonly occurring skin growth caused by a virus. Several different types of therapies have been used over time for the treatment of warts on the hands and feet. During the last 50 years, these therapies have included surgical excision, freezing, burning, treatment with acids and other chemicals, and x-rays. During the 1940s and 1950s, x-ray therapy provided a better-than-average method for removing warts. X-ray therapy was thought to be clean, pain-free, and requiring only one or two treatments to remove the warts. As late as 1956, x-ray therapy was still the treatment of choice by some physicians.

As with other radiation therapies for non-malignant skin growths, the treatment of warts with x-rays was discontinued in favor of less toxic and more effective chemical treatment.

References:


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CONSOLIDATED LIST OF HUMAN RADIATION EXPERIMENTS

A number of human radiation experiments have been identified from the recent document search efforts in addition to those previously described in the 1986 Markey Report. Although these experiments represent a broad spectrum in terms of purpose, numbers of subjects, radioisotopes, degree of severity, dates and places, the following are given as examples:

1. Iron Metabolism in Human Pregnancy as Studied with the Radioactive Isotope Fe-59

Iron-59 ingestion studies were conducted at the Vanderbilt University Hospital during the years 1942-1949 to determine the absorption of iron during pregnancy. Researchers also studied iron-59 distribution in fetal tissues and transfer rates from the women to fetuses. One group of 819 healthy pregnant women ingested tracer amounts of Fe-59, and 466 of these women were studied during return visits to Vanderbilt between 1947 and 1950. The journal article in *American Journal of Obstetrics and Gynecology*, vol 61, 1951, pp 477-486, notes that the 466 women received single doses ranging from 1.8 to 120 mg of Fe-59. Another article located in the *American Journal of Epidemiology*, vol 90, 1969, pp 1-10 notes that the fetal radiation doses have been estimated as 5 - 15 cGy (rad). The early studies were funded by the Nutrition Foundation, the Rockefeller Foundation, and the State of Tennessee. Follow-up studies to determine long-term health effects in children born to these mothers were funded by the Public Health Service and the Atomic Energy Commission. Radiation doses to maternal blood were estimated to be about 0.2 rad. A small increase in cancer incidence was observed in these children (3 cases in 634 exposed children compared to none in 655 comparison children).

2. Uptake of Iodine-131 in Thyroids of Psychiatric Patients

Iodine-131 was injected into hospital patients to study the thyroid gland and investigate new methods for treating thyroid cancer. A laboratory report to the Atomic Energy Commission describes the "problem of investigating psychiatric patients with radiiodine" to supply baseline information about normal thyroids. Sixty-five of the human subjects were patients from the Langley Porter Clinic for mental diseases. They were studied to determine whether any abnormal thyroid function existed in patients with mental disorders. No abnormal thyroid function was found, so this group constituted a normal thyroid control group. The Atomic Energy Commission partially funded this work, and the research is described by Dr. Robert Stone in a progress report of the University of California Radiation Laboratory for the period July 1, 1949 to April 15, 1950. The results were published as "Thyroid Function in Mental Disease Measured with Radiiodine, I-131," in the *American Journal of Psychiatry* 106:561-572.
3. Distribution of Chlorine-38, Sodium-24, and Bromine-82 in Extracellular Fluids of Chronically Ill Patients

The total volume of extracellular fluids in 15 humans was studied at Brookhaven National Laboratory during the period 1952 to 1953. Five chronically ill hospital patients were injected with Cl-38 and Na-24, prepared at the Brookhaven Reactor. Ten other patients were injected with Cl-38 and Br-82. Total radiation doses were planned so that the weekly dose limit of 0.3 rep (0.3 rad) would not be exceeded. Blood samples were drawn at various times post-injection and counted for radioactivity. The patients were considered to be "normal" subjects for purposes of this study. This work was funded by the Atomic Energy Commission, and was reported in BNL-1326, "Chloride, Bromide, Sodium, and Sucrose Spaces in Humans," by J.L. Gamble, Jr., J.S. Robertson, C.A. Hannigan, C.G. Foster, and L.E. Farr, dated February 4, 1953. Reference is made in the text to three other related studies in normal human subjects to determine extracellular fluid volumes.

4. Neonatal Iodine-131 Uptake Studies

University of Tennessee, Memphis, Van Middlesworth. Funded by Atomic Energy Commission to check for hypothyroidism. Dosage of iodine-131 was 1-2 microcuries, with maximum doses about 60 rep in newborns. There was informed consent, but signed records are not available. Seven male infants (one white and six black) were included in the study. An article in the AMA American Journal of Diseases of Children, 1951, pp 439-442, by Van Middlesworth describes the experiment.

A journal article (Journal of Nuclear Medicine vol 4, 1963, p 162) mentions a study conducted by the State University of Iowa, supported in part by grants from Atomic Energy Commission Biology and Medical Division (AT(11-1)291) and the American Cancer Society (T-159C). Seventeen newborn infants received 1 uc I-131 intramuscular radioiodine to study thyroidal uptake. Eight newborns received oral radioiodine. Scientists included R.T. Morrison, J.A. Birbeck, T.C. Evans, and J.I. Routh.

Studies using iodine-131 in newborns are cited in the following: Pediatrics, vol.17, 1956, p 503, E.E. Martmer, K.E. Conigan, H.P. Charbendeau, and A. Sosin; and Pediatrics vol 26, 1960, p 771. The first article notes that Martmer et al reported in 1956 on the thyroid uptake of I-131 in 65 premature and 5 term infants (aged 1 to 63 days). The infants received a 5 microcurie oral dose. The second article cites a second study in 1960 reported by Ogborn, et al, where the radioiodine uptake in the thyroid of 28 newborns (3 to 7.5 days old) was studied. The infants received a dose of 5 microcuries. This appears to be the same study. It is not known if Atomic Energy Commission sponsored the study.

5. Uptake of Radioiodine in Human Embryos

Studies were conducted at the University of Iowa during 1953 on the uptake of iodine-131 in human embryo thyroids. Dosages of 100 to 200 microcuries of
I-131 were given to pregnant women scheduled for therapeutic abortion. The aborted embryos were sectioned and autoradiographed. The human embryos showed thyroid uptake at four weeks, nearly one month sooner than was previously known. This finding was important to medicine in understanding transmission of radioiodine across the placental barrier. The information gained from this study was also useful for determining the amount of radioiodine that could be given to pregnant women and the time it could be given in terms of protecting the unborn child. The number of subjects is not known. This work appears to have been funded by the Atomic Energy Commission. The work is reported in the Monthly Status and Progress Report of the Commission's Division of Biology and Medicine for the month of June 1953.

6. Strontium Injection Studies

During the Strontium Metabolism meeting at the Atomic Energy Commission, Division of Biology and Medicine on January 27, 1954, a discussion was held on pathological changes produced by strontium. Dr. Joseph Hamilton mentioned that Dr. Friedell administered 10 millicuries of strontium-89 to a patient, which was considered to be "about a lethal dose." This evoked a "searching of minds" for cases of accidental exposure in humans and a number of such instances were recalled.

The Health Division Progress Report, November 20-December 20, 1954 (Los Alamos) mentions the intravenous injection of strontium-89 to study distribution of strontium among serum proteins. The summary does not state whether this study was human or animal, or whether it is related to the study noted in the above paragraph.

For perspective, in June 1993, the U.S. Food and Drug Administration approved the injection of strontium-89-chloride for palliation of painful bone metastases. The approved dosage is 4 millicuries.

7. Plutonium Ingestion Study

On May 13, 1946, six male employees of the Metallurgical Laboratory of the Manhattan Engineer District in Chicago drank a water solution containing 400 counts per minute (about 0.18 nanocuries) of plutonium-239. The study is documented in a June 26, 1946, memorandum from E.R. Russell to J.J. Nickson (Director of the Health Division at the Metallurgical Laboratory). The purpose of this study was to investigate the gastrointestinal absorption and fecal excretion rate of ingested plutonium. Scientists also hoped to use results to improve the interpretation of plutonium exposure and bioassay data collected from occupationally exposed persons. Participation in this experiment was entirely voluntary, and the amounts of plutonium were sufficiently low as to be barely detectable in urine and feces with instrumentation available in 1946. At least two of the subjects were still alive in 1994.
8. Tulane Studies

A series of metabolic experiments were conducted at Charity Hospital and Tulane University. The primary focus of the experiments was to investigate the role of electrolytes in congestive heart failure patients. The total number of subjects studied is not well known and some may have participated more than once. Follow-up journal articles describing the studies have been published. Approximately 269 subjects were included in the study, although some of these subjects may have participated in more than one study. Radioisotopes used included: mercury-203, 205, chlorine-36, sodium-22, 24, rubidium-86, and potassium-39, 42. One subject received only X-ray radiation to examine the radiation effects on the human subjects. The radioisotope studies examined retention times, excretion rates, biologic decay rates, and a variety of other physiological parameters.

9. Uptake of Tritiated Thymidine by Tumors in Cancer Patients

In 1962, tritiated (H-3) thymidine, a DNA synthesis tracer, was injected into four cancer patients scheduled for surgery. The rate of tritium uptake was studied in tumors and in normal cells. The study also examined the tumor cell proliferation process. Tissue was removed from the tumor and from normal skin for comparison. Results confirmed previous results in experimental animals: that tumor cells do not necessarily proliferate faster than normal cells. The study was a joint project of the Northwestern University Medical School, the Veterans Administration Research Hospital, and the Argonne National Laboratory, with funding from the Atomic Energy Commission. Dr. R. Başerga may have been one of the principal scientists. Other participating scientists include G. C. Henegar, W. E. Kisieleski, and H. Lisco. The study is reported in "Uptake of Tritiated Thymidine by Human Tumors In Vivo," Laboratory Investigation vol II, no. 5, May 1962, pages 360-364. (From series Tritiated Thymidine Injection Experiment, Argonne National Laboratory.)

10. Effect of Oral or Injected Phosphorus-32 on Hemoglobin Metabolism in Patients with Polycythemia Vera

This study was conducted by the Health Division of the Metallurgical Laboratory at the University of Chicago Hematology Clinic (six patients) and at the University of Minnesota (one patient). Five patients received an oral dosage of 15-40 millicuries P-32, and two patients were injected with undetermined amounts of P-32 in a study of the metabolism of hemoglobin metabolism in man. These experiments took place between October, 1944, and June, 1945. Five of the case descriptions are reported in "Studies of the Hemolytic Effect of Radiation," by S. Schwartz, E.J. Katz, L.M. Porter, L.O. Jacobson, and C.J. Watson, in Report CH-3760, Metallurgical Laboratory, Chicago, July 10, 1946 (National Archives, Argonne Collection). This report does not address whether patient benefit was expected or observed.
11. Arsenic-76 Biodistribution and Excretion Studies

Twelve hospital patients were injected intravenously in 1947 with As-76, as potassium arsenite, to study the uptake, retention, distribution, and excretion of arsenic. The study was conducted by the Argonne National Laboratory in 1947, in Chicago. The subjects included five males and seven females hospitalized with leukemia, Hodgkin's disease, polycythemia vera, melanocarcinoma, and carcinoma of the parotid, and ranged in age from 18 to 67. Amounts of As-76 administered were 0.5 to 13.8 millicuries. The study was reported in "Arsenic-76 Preliminary Studies," a progress report, by Dr. W.B. Neal, Dr. L.O. Jacobson, H. Ducoff, and T. Kelly, Argonne National Laboratory, Biology Division, June 1, 1947 (Part of CH-3830, National Archives, Argonne Collection).

12. Colloidal Gold-198 Studies at Oak Ridge

The Seventh Annual Report of the Oak Ridge Institute of Nuclear Studies (June 30, 1953), described the administration of colloidal gold-198. The experiment was conducted in the hope of having a therapeutic effect on two individuals who had cancer of the liver. Several other human subjects with advanced cancer were injected with colloidal Au-198, shortly before their death, to study the metabolism and biodistribution of colloidal gold. A report on these experiments results was published in Cancer 6(2), March 1953.


The Sixth through Ninth annual reports of the Oak Ridge Institute of Nuclear Studies (June 30, 1955) describe the early clinical use of injected lutetium-177, yttrium-90, gold-198, iodine-131, gallium-67, gallium-72, and strontium-85. Some of the work was reported in Radiology 61(4):534-613, 1953; Cancer 7:856-866, 1954 (gold-198), and in Radiology 63:251-257, 1954 (colloidal P-32). The purpose of these studies was to investigate the therapeutic properties of various radioisotopes for treating cancer. In many cases, a therapeutic benefit to the patient was hoped for. However, there were also a number of metabolic studies that were conducted using terminally ill cancer patients to determine the biodistribution and retention of different radioisotopes, and their rates of excretion from the body. These studies were supported by the Atomic Energy Commission and are considered to be pioneering studies in the development of the field of nuclear medicine.

14. Decompression Sickness Studies using Radioactive Gases

Human subjects breathed air tagged with radioactive nitrogen and argon gases. Nitrogen uptake was then monitored. These experiments took place during the 1980's at Lawrence Livermore National Laboratory.
15. In-Vivo Calibration Studies Using Humans Administered Niobium-92m, Barium-133, and Strontium-85 at Lawrence Livermore National Laboratory (and other DOE laboratories)

Subjects in the United Kingdom were injected with radioactive barium or strontium, or inhaled radioactive niobium, and then were whole-body or chest-counted at Lawrence Livermore National Laboratory and other DOE sites in the U.S. The purpose of these studies was to develop accurate calibration factors for in-vivo counting equipment and to intercalibrate the various U.S. and British in-vivo counting centers. Several studies took place during the period 1978-1989. H.E. Palmer at Pacific Northwest Laboratory and H. L. Anderson at Lawrence Livermore National Laboratory were two of the principal scientists for the study.

16. Ozone Effects on Overall and Regional Lung Function

Human subjects inhaled radioactive nitrogen or carbon dioxide to determine functional changes that might be caused by low concentrations of ozone from smog. The study was performed by the University of Washington under a contract from the Department of Energy (DOE) from 1977 to 1978.

17. Technetium-99 In-Vivo Counting Experiments

Subjects were injected with technetium-99 microspheres and then placed in the whole-body counter at Lawrence Livermore National Laboratory to determine whether technetium-99 could be used to calibrate in-vivo counting equipment for direct measurements of plutonium-239 in workers accidentally exposed to plutonium.

18. Calibration Studies on Los Alamos Firemen Ingesting Radionuclides

Firemen at the Los Alamos National Laboratory ingested small amounts of radioactive materials and participated in a study to calibrate the HUMCO II liquid scintillation counter and compare results with measurements made on earlier versions of whole-body counters.

Zinc-65 (1 microcurie) was administered orally to humans and four animal species. The in-vivo time changes were observed using the liquid scintillation human-body counter (HUMCO I) and a sodium iodide gamma-ray spectrometer. The study was intended to examine the effects of fallout from atomic testing and activation products.

19. Retention and Excretion of Iodine-131 in Man

A series of studies were performed to measure the biological retention half-times in man and their excretion from the body using ultra-high-sensitive liquid scintillation counters. Tracer amounts of radioisotopes were administered, and rates of retention and excretion were measured using the whole-body counting equipment. A summary from the May 16, 1994 Los Alamos press release notes a study in which 26 people ingested 8 microcuries of
iodine-131. The intent of the study was to determine how long the body retained the iodine-131. The subjects were then placed in Los Alamos' whole-body radiation counter. Another report, LAMS-2455, Biological and Medical Research Group (H-4) of the Health Division - Semiannual Report January Through June 1960, contains a report of the injection of 28 subjects with radioactive iodine-131. These persons were then placed in the whole-body counter.

20. Experiments to Study Coordination and Psychomotor Responses After Exposure to External Penetrating Radiation

Experiments were performed on human subjects to determine coordination and psychomotor responses before and after external radiation in human subjects as part of a larger project called NEPA (Nuclear Energy for the Propulsion of Aircraft). The development of nuclear reactors was a joint Air Force/Atomic Energy Commission project. In 1949, the project's medical advisory committee recommended a wide range of human experimentation designed to determine how pilots would be affected by the radiation exposure they would experience while flying a nuclear-powered aircraft. Much of the proposed human experimentation was not carried out; however, there are some documents pertaining to limited studies on the effects of radiation on neurosensory function. This work was conducted at the M.D. Anderson Hospital in Houston, Texas, during the period 1950 to 1952. (Memorandum from C. S. Shoup to Kenneth Kasschau, March 12, 1952).

21. Studies of 60-Hertz Exposure Effects on Human Function

Studies on the effects of non-ionizing electromagnetic field radiation were conducted on humans to determine effects on the cardiovascular system. Recording sensors were attached to the chest and arm to measure the electrocardiogram (ECG), heart rate, blood pressure, respiration, and oxygen saturation. Subjects were assigned at random to either a sham exposure group or a magnetic field exposure group. The subjects were to sit in the exposure facility for a period of three hours. Exposures were to be intermittent (alternating 45 cycles), and the magnetic field strength was to be 200 milligauss. These experiments were to have been conducted by the Midwest Research Institute in conjunction with Oak Ridge National Laboratory. It has not been determined whether these experiments actually took place. Documentation from DOE/Oak Ridge Operations includes approvals from DOE and from the Department of Health and Human Services (DHHS), with assurance of compliance with DHHS regulations and documents.

22. Human Radiation Experiments at Vanderbilt University on the Metabolism of Radioisotopes

Human radiation experiments were conducted at Vanderbilt University under Contract AT-(40-1)-2402 with the Atomic Energy Commission. There are many supplements to this contract that individually specify the type of studies to be conducted. These studies ranged in scope from the performance of accurate measurements, quantification of isotopes and isotopic metabolism, the
absorption of radioactive isotopes in adult and fetal tissues, the effects of iodine on the thyroid during therapy, and other studies. These studies occurred from 1958 to 1978.

23. Human Fetal Studies on Protein and Lipid Metabolism Using H-3 and C-14

Tritium (H-3) and carbon-14 tracer studies were conducted by the Los Alamos Health Division in collaboration with the Chicago Lying-In Hospital and Argonne Cancer Research Hospital. Subjects included five women undergoing therapeutic abortions at the Chicago Lying-In Hospital. These studies showed that cholesterol, fatty acids, and tissue proteins were synthesized in the human fetus and very small amounts transferred across the placental barrier. Orally administered cholesterol was labeled with tritium (H-3) (a dose of either 10 microcuries or 50 microcuries) and was found in the fetal part of the placenta. Carbon-14-labeled acetate was injected also (100 microcuries). The relative rates of cholesterol biosynthesis from acetate-1-carbon-14 and from various other substrates in all fetal organs and certain maternal tissues were also determined. A summary of this work is described in the 1954 LA-1889 Annual Report, Biomedical Research Group Health Division; the 1957 Annual Reports of the Los Alamos Health Division; Annual Report, Biomedical Research Group, Health Division LA-1690 1953, and the H-Division Progress Report July 20 - August 20, 1954. Leroy, Davison, and Gould conducted the studies. Gould, Leroy, Okita, Kabbara, Keegan, and Bergenstal participated in this study. Gould and Leroy appear to have been the principal scientists for the study series. Another document, H-Division Progress Report, February 20 - March 20, 1955, noted that 34 subjects received carbon-14 labeled acetate as part of the same study. A collaborative study between LASL and the University of Chicago examined cholesterol metabolism in coronary patients. At least two subjects received an oral dose of tritium-labeled cholesterol. Two patients died (from their disease) and tissue samples were analyzed at LASL. The 1953 annual report notes that 10 subjects at Argonne and subjects and controls in Santa Fe also received tritium-labeled cholesterol. Another tracer study using tritium-labeled cholesterol (33.8 microcuries) and carbon-14-labeled cholesterol (4.24 microcuries) was part of this series. One male with chronic rheumatoid arthritis received an injection to determine the percentage of urinary steroids derived from cholesterol. (This work is reported in The Journal of Clinical Endocrinology and Metabolism, "Evaluation of Tritium Cholesterol as a Tracer in Man, Harold Werbin, Delbert Bergenstal, Gordon Gould, March 1957, volume 17, number 3).

24. Studies on Human Exposure to Neutron Radiation

Human subjects irradiated with neutrons were evaluated by counting their activated sodium-24 at Los Alamos National Laboratory (summary in the 1957 Annual Report of the Los Alamos Health Division).

The radioisotopes Na-22, K-42, Rb-86, Cs-134, and Cs-137 were administered to human subjects and measured over time in the human body-counter. The retention patterns for most were followed for about one year; in one man, the retention pattern of cesium was followed for about two years. This study may have been a collaboration with the Argonne Cancer Hospital in Chicago. A summary of this work is described in the 1957 Annual Report of the Los Alamos Health Division. See also the Group H-4 Semianual Report, LAMS-2445 July 1959 - December 1959. (The number of subjects is not known from the summary).

Another Los Alamos document, Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LAMS-2780, July 1961 through June 1962, describes an experiment where potassium-40 and cesium-137 were measured in 58 control subjects. Anderson is cited as the researcher. These subjects may not have been "dosed." Fifty control subjects are cited in Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LA-3132-MS, July 1963 - June 1964. The researcher for this study was Dean.

A study was made at the Los Alamos National Laboratory of the whole-body retention of Cs-137 in 3 male subjects given 0.3 microcuries of Cs-137 (approximately 30 times the cesium-137 body burden due to fallout). This study is reported by the Biological and Medical Research Group (H-4) of the Health Division, in the Annual Report LA-3432-MS, for July 1964 through June 1965. Other Los Alamos documents that may contain pertinent information are (Biological and Medical Research Group (H-4) of the Health Division - Semiannual Report, LAMS-2627, January through June 1961; and Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LA-3132-MS, July 1963 - June 1964. The 1964 annual report notes 0.3 microcuries of cesium-137 administered orally to two subjects. Four subjects were used in tracer studies.

Cesium-132 retention was measured in four human subjects who were injected intravenously at Los Alamos National Laboratory during 1962 to 1963. This experiment was conducted to determine the short-term retention component of cesium in the body. An account of this study is given in the annual report of the Biological and Medical Research Group (H-4) of the Health Division (LAMS-3034), July 1962 through June 1963.


A study was conducted by Los Alamos National Laboratory in about 1957 to determine the survival times of circulating blood erythrocytes (red blood cells) in healthy and diseased subjects. Thirty-two human (7 well and 25 ill) subjects received intravenous injection of samples of their own red blood cells that had been previously removed and tagged with radioactive Cr-51. After tagging, the red cells were injected back into the subject's body, and the person was counted in the human body-counter. Half-times for the survival
of the chromium tag were determined. Large volumes of urine were also obtained from the subjects and counted to determine excretion rates. This study may have been a collaboration with the Argonne Cancer Hospital in Chicago. A summary of this work is described in the 1957 Annual Report of the Los Alamos Health Division.

27. Absorption of Iodine-131 and Uptake of Sodium-24 in Human Subjects

One subject cutaneously absorbed 10 microcuries of sodium-24 (palm). Another subject received 51 microcuries of iodine-131 on the palm. The same isotopes were orally ingested (0.18 microcuries of sodium-24 or 0.14 microcuries of iodine-131). It is not clear from the summary whether the same two subjects were used for these experiments. These are described in document LAMS-2526, Biological and Medical Research Group (H-4) of the Health Division - Semiannual Report July Through December 1960.

28. Retention of Iodine-131 in Subjects with Inflammatory Liver Disease

Ten normal subjects and 18 persons suffering from various (but mostly inflammatory) hepatic disease were injected intravenously with 10 microcuries of I-131-labeled rose bengal. The time-activity curves for I-131 were determined using the arm counter at Los Alamos National Laboratory. The blood-retention curve was found to be a better measurement of function than the clearance rate itself by rose bengal dye excretion techniques. This study is reported by the Biological and Medical Research Group (H-4) of the Health Division, Semiannual Report LAMS-2455, January through June, 1960.

29. The Fate of Radon Ingested by Man

Two male subjects, on two occasions received an oral dosage of about one millicurie of radon dissolved in 100 ml of water. The study occurred in Rochester, New York. Information located in "The Fate of Radon Ingested by man", Health Physics, Vol 11, 1965, pp. 465-476.

30. Preliminary Human Experiment on Inhaled Zirconium-89

Preliminary inhalation studies using an active smoke containing the 81-hour Zr-89 were completed in 1945 (Progress Report for the Month of October 1945, Lawrence Berkeley Laboratory, Dr. Joseph G. Hamilton Records). The Atomic Energy Commission funded the study (contract W-7405-eng-48A) for the University of California. The work occurred at the Divisions of Radiology and Medicine, University of California Medical School, San Francisco, and the Division of Medical Physics and Crocker Laboratory, University of California, Berkeley. Only one human subject was used ("one of us"). The purpose of the experiment was to determine the degree of retention by the lungs of very finely divided active smoke suspended in air. The results showed that almost 100 percent of the inhaled activity (total activity inhaled = 2,430 counts per second, or about 0.5 microcuries) was retained within the lungs and upper respiratory tract. Only 32 percent of the total activity was excreted. The
report notes that future studies using the short-lived zirconium isotope in
humans were planned for the near future. (DEPARTMENT OF PH. URANIA AND
HEU FUSION PRODUCTS INHALED AS CTHODES) (700091) PH 32

31. Radium as an Experimental Therapy for Treating Mental Disorders

Patients of a state mental hospital were injected with radium as an
experimental therapy for mental disorders. The experiment appears to have
been conducted in Elgin, Illinois, at the Elgin State Hospital between 1931
and 1933. Document indicate that 70 to 450 micrograms of radium-226 were
injected. This experiment occurred prior to the establishment of the Atomic
Energy-Commission or Argonne National Laboratory. Argonne National Laboratory
later collected records and attempted to locate the patients. Researchers
believed that if the patients could be located and body content measurements
made in the 1950s, a valid retention curve for radium in humans over several
decades could be constructed. Argonne National Laboratory made all later
measurements. This information was useful for radiation protection guidelines
for alpha particle emitters. The records contain information regarding radium
content of the located subjects, medical information relating to the subjects' admission to the hospital, periodic medical examination results and causes of death and death certificates for deceased subjects. (Records from the Series
Elgin State Hospital Records, Center for Human Radiobiology).

32. Distribution of Zinc in Normal Blood and Organs Using Zinc-65

Researchers in Boston administered radioactive zinc-65 to a 67 year-old person
suffering from myelogenous leukemia, and to a healthy control subject. The
intent was to determine white cell zinc-65 content and the distribution of
zinc in normal blood and organs. Analysis occurred over a long period of time
to track zinc-65 retention. Principal scientists included John G. Gibson,
2nd, Bert L. Vallee, Rex G. Fluharty, and J. Eugene Nelson. The experiment
occurred in September 1947, and experimental information was presented at the
Fourth International Cancer Research Congress. Injections ranged from two mg
per day to "far in excess of this amount." This study may or may not have
been funded by Department of Energy predecessors agencies.

A summary contained in the May 16, 1994, news release suggests that Los Alamos
has documentation on this experiment, and may have conducted the experiment.
(Refer to LAMS-2526, Biological and Medical Research Group (H-4) of the Health
Division - Semiannual Report July Through December 1960). According to this
summary, two people swallowed zinc-65 chloride as part of a study of the long-
term retention of the compound. The studies were conducted by C.R. Richmond,
J.E. Furchner, and W.H. Langham for a period of one to two years. Two
subjects (not known if the same two) were used to study the effects of
differing levels of zinc in the diet on the absorption of orally administered
zinc-65. J.E. Furchner, C.R. Richmond, and F.A. Trafton conducted this study.
See also Biological and Medical Research Group (H-4) of the Health Division
Annual Report. LAMS-2780, July 1951 through June 1962; and Group H-4
Semiannual Report, LAMS-2445 July 1959 - December 1959. This
citation notes an oral dose of 0.76 microcuries of zinc-65 to two subjects -
third and fourth in the experiment series by Furchner.
Another Los Alamos citation (Biological and Medical Research Group (H-4) of the Health Division - Semiannual Report, LAMS-2627, January through June 1961) notes iodine-131 studies by Furchner involving 17 subjects. The summary provided also notes that zinc-65 was given to a terminal leukemia patient, a 15-year old girl.

### 33. Clinical Testing of a Line-Scanning Proportional Counter Camera Using Injected Iodine-125 and Technetium-99m

Diagnostic dosages of I-125 and Tc-99m were administered to selected patients referred to the Oak Ridge Hospital for thyroid evaluation. The quality of the images obtained with the two radioisotopes with the camera were evaluated and compared. Although these subjects were evaluated for pre-existing disease, certain aspects of this study were experimental, and the objective was development of instrumentation and techniques for evaluating human thyroids. An estimated 100 subjects were studied (medical chart review still pending). This study occurred from August 27, 1975 to September 29, 1977. The protocol was approved by Oak Ridge Associated Universities (ORAU)/Oak Ridge National Laboratory (ORNL) Institutional Review Board (IRB).

### 34. Radium Injection Experiment

About 440 micrograms (440 microcuries) of radium-226 were injected into the body of a human subject. The date and location of this experiment are unknown, but it is likely that the experiment took place in Berkeley or San Francisco prior to 1945. As much as 11.4 micrograms Ra-226 were retained in the subject's body at time of death, many years after injection. The record is found in the Joseph G. Hamilton Record Collection, Lawrence Berkeley Laboratory. Another record located in the same collection is a partial memorandum from someone in the Army Service Forces, U.S. Engineer Office, Oak Ridge, to the file regarding tolerance values for radium and plutonium.

### 35. Metabolism of Calcium and Radiostrontium in Infants

Experiments on calcium and radiostrontium metabolism were conducted by Jean and Justine Burg for 2-1/2 years (1960 to 1962) at Crocker Laboratory, Berkeley, California. The experiment appears to have examined calcium metabolism in three infants, with strontium as a tracer. Diapers were obtained and calcium was counted through excretion; retention was also recorded. Calcium intake was also recorded (from milk and other foods).

### 36. Californium-252 Cancer Radiotherapy Program

Californium-252 was implanted into tumors of 18 terminal, volunteer patients, whose clinical condition precluded curative intent. It was hoped that these experiments would show feasibility of Cf-252 implants in cancer therapy. These experiments occurred about 1971, possibly at Brookhaven National Laboratory, the University of Pennsylvania, Columbia University, the University of Cincinnati, or Memorial Sloan-Kettering Cancer Center. Agreements were reached with Christie Hospital and United Oxford Hospitals,
both in Great Britain, for the Cf-252 loan program, for use in cancer radiotherapy.

37. Astatine-211 and Iodine-131 Injections

Eight human subjects were injected with the 7-hour half-life alpha-emitter At-211. Three of the same subjects also received injections of I-131 to compare iodine with astatine (both are halogens). It appears that researchers intended to study the uptake of orally administered astatine-211 by the thyroid in patients with various thyroid disorders. These experiments were conducted at the University of California Hospital during early 1954. The principal researcher seems to have been Dr. Joseph Hamilton. Others mentioned are: Dr. Rusted, Dr. Bell, Dr. David E. Brown, Dr. William A. Reilly (Director), Dr. Searls, Dr. Edmiston, and Dr. McCorkle. Pathologists also participated: N. Malamud; Wilfred E. Toreson, Stuart Lindsay, Warren Bostick, A. Johnson, J. Visalli, and M. J. Aguilar (University of California Hospital); George Watson (Hahnemann Hospital).

38. Total-Body Neutron Activation Analysis

Approximately 40 to 50 females with known bone-wasting disease and 25 chronically ill adults suffering from kidney failure received a uniform low flux high energy neutron exposure. The Atomic Energy Commission funded this study, which occurred from 1969 to 1973, possibly at University Hospital, University of Washington, Seattle.

39. Study of Chromium-51-labeled Blood in Normal Volunteer Subjects

Chromium-51 was used to tag red blood cells, which were then injected in normal volunteers in quantities equal to those used clinically in blood volume determinations. The estimated number of volunteers was about 50. These studies led to the use of adenine as a blood preservative. These studies may have involved foreign human subjects in Bangkok, Thailand. The University of Washington, Seattle, may have conducted the study.


Los Alamos has documentation (Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LAMS-2780, July 1961 through June 1962) regarding the oral administration of 0.275 microcuries of iron-59 to 20 men and 30 women. Dr. Clarence Lushbaugh is cited as the researcher. Another document, Group H-4 Semiannual Report, LAMS-2445 July 1959 - December 1959, indicates that 0.5 to 0.7 microcuries of iron-59 were given orally to 66 persons, including one 7-month pregnant woman. These people were then studied by periodic measurements in the whole body-counter at LANL. The intent was to determine the percent retention of the administered dose. Lushbaugh and Hale are cited as researchers.

The Richland Collection, Bate numbers 8759 to 8760 indicate that iron-55 and iron-59 were injected into about 20 normal and about 60 to 80 diseased
(anemic) subjects. Approximately 5 to 10 microcuries were injected. The Atomic Energy Commission-sponsored studies led to a physiologic classification of red cell production.

41. Ingestion of Iodine-131 in Milk by Hanford Employees

Eight GE/Hanford workers ingested iodine-131 in milk in order to determine the uptake of iodine-131 in the thyroid. The milk was drawn from a cow that had been fed five microcuries of iodine-131. This experiment occurred in Richland Washington.

42. Effects of X-Rays on Mitosis of Human Skin

An experiment was conducted at Los Alamos National Laboratory on the effects of X-rays on the mitotic activity of human skin. Principal scientists included Norman Knowlan and Louis Hempelmann. (From H-Division Progress Report, LAMS-790; August 20 - September 20, 1948.

43. Metabolism of Carbon-14-labeled Chelating Agent

Some human subjects received the chelating agent CaEDTA intramuscularly, orally, and cutaneously for a metabolic study. (The Journal of Laboratory and Clinical Medicine, "The Metabolism of C-14 Labeled Ethylenediaminetetra-acetic Acid in Human Beings", Harry Foreman, Theodore T. Trujillo, April, 1954, volume 43). Document found at Los Alamos. These metabolic studies are cited in another Los Alamos document, the 1953 annual report.

44. Strontium-85 (Los Alamos Records)

Los Alamos annual report (Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LAMS-2780, July 1961 through June 1962) cites an oral dose of 1.07 microcuries of strontium-85 given to three males. Furchner is cited as the researcher. This same report also cites cutaneous absorption of 70 microcuries of strontium-85 in 2 subjects. Van Dilla is cited as the researcher.

45. Iodine-131 Studies (Los Alamos)

Two studies by Lushbaugh are mentioned. One involves the administration of 0.5 microcuries of iodine-131 to two women, one adult, and one infant. The other is the injection of 0.7 microcuries of iodine-131 in eight subjects. The Biological and Medical Research Group (H-4) of the Health Division - Annual Report, LA-3132-MS, July 1963 - June 1964 contains an abstract of an article in Science about radiiodine metabolism in children and adults (Van Dilla is the author). Another article written by Van Dilla (Health Physics vol 9, 1963, pp 1325 - 1331) cites a thyroid metabolism study in children and adults using nanocurie doses of iodine-125 and iodine-131. Another document, Group H-4 Semiannual Report, LAMS-2445 July 1959 - December 1959, cites a study where patients received iodine-131 orally to study thyroid uptake,
retention, and function (counting occurred in the whole body-counter). This study was also a Lushbaugh study.

46. RaLa Experiments

The 1953 annual report (Los Alamos) mentions an absorption study of barium-140/lanthanum-140 (RaLa) in humans. Foreman is cited as the researcher.

47. Thyroidal Deposition of Iodine-131 in Man, Rat, and Dog, From Milk and Nonmilk Sources

This study was located by Idaho in a Health Physics article, vol 9, 1963, pp 1249 - 1252 (Idaho was not involved). The study involved the ingestion of iodine-131 in water solution and cow’s milk in 11 adult humans. Rats and dogs were studied also. The experiment was conducted by New York State Veterinary College and Cornell University, under contract with the Atomic Energy Commission. Principal researchers may have been C.I. Comar, R.A. Wentworth, and J.R. Georgi.


One part of Project Sunshine under Atomic Energy Commission Contract A-930-1-1656 involved the evaluation of strontium metabolism in relation to calcium in humans. Arthur R. Schulert was the principal scientist for this portion. Dr. Daniel Laslo and associates from the Division of Neoplastic Diseases, Montefiore Hospital, New York, assisted with the study. Researchers administered strontium-85 and calcium-45 simultaneously and intravenously to terminal cancer patients. The report does not state the amounts injected. Observation occurred from three days to three months. From the data presented, it appears that ten patients received injections. A large variety of body tissues were analyzed for each isotope for each patient after autopsy. Doses ranged from 10.1 to 108.5 microcuries for strontium-85 and from 15.2 to 88 microcuries for calcium-45.

The Hamilton Collection

The Department of Energy has identified descriptions of various radiation experiments in the Joseph Hamilton Collection. These documents are currently being redacted. As soon as the Privacy Act redaction process has been completed, these documents will be released to public reading rooms.
Dear Dr. Siri:

I enjoyed visiting your laboratory greatly and should have written sooner to thank you. You were most generous with your time, and extremely helpful.

I am convinced that progress in the field of body composition studies will be greatly hastened by exchange of ideas between workers in the field and I hope we can continue to compare notes.

As far as our work here goes, we have decided that setting up methods for both body water and body density in human subjects is too ambitious a project, with the facilities and time available, and are therefore pursuing a less direct line of approach. We are working with $^{15}$-labelled urea as a measure of body water in patients, with an aim to try to find constant ratios between this space, radioulsfate space, and red cell mass. In animals we are repeating some of Pace's earlier work on body water vs. body fat.

I am particularly interested to learn if you have found any more constant relationship between body density and body water or extracellular water. If I can convince the Navy (and myself) that a constant relationship does exist, I am confident they will support construction of a chamber like yours here at Bethesda. Have you tried radioulsfate?

If you get East be sure to come by for a visit.

With best regards,

Sincerely yours,

[Signature]

Mackenzie Walker
LT, MC, USNR
CHAPTER 1. INTRODUCTION

1.01 DEFINITIONS

a. "R&D (Research and Development)" in the Department of Medicine and Surgery includes the investigation and refinement of biomedical problems and hypotheses related to human health, diseases, defects, and handicaps as well as the systematic study and refinement of problems and hypotheses related to the delivery of health care.

b. "Research" is the testing of concepts by the scientific method of hypothesis formulation, systematic and recorded collection of relevant data, and interpretation of the results in terms of the hypothesis.

c. "Development" is the application of research to practical ends with the intent of producing useful devices or techniques rather than the testing of concepts. It can involve nonroutine evaluation of new or existing devices and techniques and may employ the scientific method. The output includes the initial formulation of products, whether devices or techniques, correction of defective products, and improvement of existing products.

d. "Principal investigator" is the individual who is accountable for the proposal, performance, and culmination of a research or development project.

e. "Co-principal investigator" is one of two or more principal investigators who share equally in the accountability for a project.

f. "Cooperating investigator" is the person at any one VA facility who is accountable for the facility's participation in a study that involves two or more facilities.

g. "Collaborating investigator" is any other investigator who participates in a project; generally persons are considered as "collaborating" if they will be included as joint authors of the final presentation of the project.

h. "Project" is a coherent unit of research or development that is proposed, pursued, and reported as a separate activity. Its scope is larger than that of a single experiment but may be smaller than that of an individual's scientific activity over a long period. As a unit, the project can be considered the work that will produce one or more published papers, formal reports, or completed devices or techniques.

i. "Program" includes one or more projects clearly related to one another. Thus, there is the program of an investigator or of a medical center as well as the program of cardiovascular research and the cooperative research program. A single project may be included in more than one program.

j. "Intramural research or development" is that performed by VA employees or appointees (including those serving without compensation), generally within VA facilities.

k. "Extramural research or development" is that performed by investigators not in the employ of the VA but financed by the VA.

l. "Cooperative study" is a project or program of research or development conducted at two or more health care facilities using a common protocol so that data obtained at all participating facilities can be treated as though from a single source.

m. "Collaborative study" is a project or program of research or development conducted at two or more health care facilities; it does not require a common protocol.

n. "Affiliated institution" generally refers to an academic institution that has a relationship with a VA medical center documented by a Memorandum of Affiliation in conformance with M-8, "Academic Affairs," Part I, Chapter 2, Appendix 2A. In addition, special purpose affiliations documented by a memorandum of understanding approved by the Director of the appropriate R&D service, VA Central Office, may be developed in R&D areas such as health services or rehabilitation research and
development. Such special affiliations will be designated as “HSR&D Field Programs” or “Rehab R&D affiliations” and the specially affiliated institution will be termed “HSR&D-affiliated” or “Rehab R&D-affiliated” institution, as appropriate.

1.02 PRINCIPLES AND OBJECTIVES OF THE RESEARCH AND DEVELOPMENT PROGRAM

a. The primary mission of the Department of Medicine and Surgery—to provide high quality medical care to veteran-patients—is served by the R&D program in three ways:

(1) The production of new knowledge, techniques, or products leading to improved prevention, diagnosis, treatment, and control of disease, as well as correction of, or compensation for, defects. These R&D products benefit veteran-patients and humanity in general.

(2) The attraction and retention of a high quality professional staff that improves the care of the VA's patients.

(3) The provision of a stimulating intellectual environment necessary for the educational programs in VA health care facilities as well as serving in support of subparagraphs (1) and (2) above.

b. These objectives can be attained only through research and development of high quality. The program, therefore, constantly strives to achieve excellence.

c. The results of development and of directly applied research, including clinical studies, can have an immediate effect on patient care. Such applications, however, depend upon research commonly called basic. Scientists performing basic studies also advise and assist other staff members in pursuing their research.

1.03 POLICIES

a. Staff members of health care facilities are encouraged to engage in R&D programs consistent with the best interests of patient care.

b. Research and development are conducted as intramural activities when this is feasible. Extramural research may be supported through contracts when this is the best or only means to achieve the program's objectives and when such support is allowed by law and VA policy. The VA does not make grants for extramural research and development.

c. The VA R&D program encourages free exchange of scientific, technical, and medical information both within and outside the VA. (See M-1, pt. 1, par. 9.66a.) In keeping with this policy, VA investigators are encouraged to report their work at professional meetings and in scientific, technical, and medical publications, and to participate in the activities of their professional organizations. While the importance of the free exchange of information is acknowledged, one must understand that presentations and publications identified with the VA reflect upon the agency. Accordingly, presentations or publications that are to enjoy the support of and identification with the agency must be, and are, subject to appropriate review for quality prior to dissemination. In reporting research, the law and agency policies regarding patient information disclosures must be observed.

d. VA funds may be used to support the exchange of technical information. Such means of exchange include, but are not limited to publications, conferences, and other professional meetings.

e. The VA recognizes the important role of research in the basic biomedical and related sciences and of basic scientists in advancing health care. Scientists, whether clinicians or not, whose work is of high quality and relevant to the VA's mission and who contribute to related functions of the health care facilities, may be supported in their research.

f. Physicians, dentists, and nurses cannot receive salaries or special pay, where applicable, from R&D funds except with the express prior approval of the Chief Medical Director. Written request(s) for exception, with justification for it, shall be submitted by the facility Director through the ACMD/R&D (Assistant Chief Medical Director for Research and Development).

g. The VA and/or its investigators can accept financial support from governmental and nongovernmental organizations for research and/or development in accordance with VA policies and programs. Such funding must use fiscal mechanisms prescribed