



Multiple Myeloma (MM) and Exposure to Ionizing Radiation

Summary: Studies conducted at the Los Alamos National Laboratory and other nuclear facilities, as well as those exposed to radiation from the atomic bomb suggest an increased likelihood of developing multiple myeloma for those who have been exposed to ionizing radiation. These findings are consistent with the determination of the National Research Council's BEIR V committee that multiple myeloma has been associated with exposure to ionizing radiation. Multiple myeloma is a "specified" cancer under the EEOICPA. Historically, multiple myeloma incidence and mortality in Los Alamos County fall in the middle of New Mexico counties while Rio Arriba County is among counties with the highest rates in the state. Incidence means new cases of cancer, while mortality means deaths due to cancer.

What is Multiple Myeloma?

Multiple myeloma is a type of cancer that affects certain white blood cells called plasma cells. Plasma cells and other white blood cells are part of the immune system, which helps protect the body from infection and disease. When cancer involves plasma cells, the body keeps producing more and more of these cells. The unneeded plasma cells -- all abnormal and all exactly alike -- are called myeloma cells. Myeloma cancer cells tend to collect in the bone marrow and in the hard, outer part of bones. Sometimes they collect in only one bone and form a single mass, or tumor. In most cases, however, the myeloma cells collect in many bones, often forming many tumors. When this happens, the disease is called multiple myeloma. Although multiple myeloma affects the bones, they begin in cells of the immune system. These cancers are different from bone cancer, which actually begins in cells that form the hard, outer part of the bone. (National Cancer Institute)

Findings of Human Health Research Studies

Human health research studies compare the patterns of disease among groups of people with different amounts of exposure to a suspected risk factor. Below are results reported from such studies of multiple myeloma among people exposed to ionizing radiation.

All of these studies found increases and possible increases in multiple myeloma (MM) among certain groups of exposed workers. Statistically significant is a term used to mean that the connection between the health outcome and the exposure was strong enough that it was unlikely to be due to chance. The research included incidence studies, which look at new cases of cancer. These can track health more quickly and accurately than mortality studies of deaths due to cancer. Adding to the strength of the findings is that increasing rates of MM were observed with higher doses in some studies.

* Findings were statistically significant (strong evidence)

+ Evidence of a dose-response relationship (strongest evidence)



Studies of Los Alamos National Laboratory (LANL) Workers

Research conducted of LANL workers provides the most direct evidence about possible relationships between a health problem and workplace exposures at LANL.

- **Study of Four DOE Sites:** LANL contributed 37 cases of multiple myeloma to a case-control study at four DOE sites. All together, the rate of death due to MM increased with increasing whole body dose of radiation received between age 40 and 50.⁷¹

Studies of Other Nuclear Workers in the United States

The next most relevant evidence comes from studies of workers in similar occupations with the same types of exposures. Listed below are studies that looked at multiple myeloma and workplace exposures among nuclear workers in other parts of the United States.

- **Hanford:** A possible increase in MM deaths was observed in 35,000 males employed between 1943 and 1972, and then followed through 1972.⁽⁵¹⁾ In later studies, this finding has depended upon the assumptions used in the analysis.^(18, 48, 52) Under certain assumptions, there are increasing rates of death due to MM with increasing doses of external radiation.^{49, 52, 72, 73 *+}
- **Mallinckrodt, St. Louis:** A possible increase in deaths from MM was observed in a study of 2,514 males who were employed between 1942 and 1966, and then followed through 1993.²
- **Oak Ridge Y-12:** The disease category of “other lymphatic cancer,” which includes MM (ICD 203), showed a possible increase in deaths in a study of 8,116 workers who were employed between 1947 and 1974, and then followed through 1990.²⁴

Studies of Other Nuclear Workers World-Wide

Below are studies of nuclear workers outside of the United States that looked at multiple myeloma in connection with radiation exposures.

- **Sellafield, England:** A possible increase in deaths was observed due to MM in a study of 5,203 plutonium workers who were employed between 1947 and 1975, and then followed through 1992. A possible increase was seen in incidence between 1971 and 1986 in plutonium workers.³ In a study of 14,327 workers who were monitored for external radiation during this time period, there were increasing rates of death due to MM with increasing doses of external radiation.^{4 *+} The researchers who conducted the study wrote: “This may represent a true radiation effect.”

* Findings were statistically significant (strong evidence)

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- **3 Nuclear Workforces in England:** Increasing rates of death due to MM were found with increasing time since first being monitored for plutonium in a study of 12,498 workers.²⁹ *+
- **Registry of Nuclear Workers in the U.K.:** Increasing rates of death due to MM were found with increasing doses of external radiation in a study of 95,000 workers.⁵ *+

Studies of Other Ionizing Radiation Exposures

Studies among other groups of people who were not nuclear workers can also be significant as evidence of possible increases in multiple myeloma among those who have been exposed to ionizing radiation. Most other research has been conducted of people exposed to atomic bombs.

- **Atomic Bomb Survivors:** Increasing deaths due to multiple myeloma with increasing doses of radiation in a study of 86,572 A-bomb survivors.^{8,74} *+

Other Research and Policy Findings

The National Research Council advises the U.S. government on scientific matters. Their Committee on Biological Effects of Exposure to Ionizing Radiations (BEIR) V reviewed sensitivity of parts of the body to radiation. Their findings are based mostly on studies of cancer among atomic bomb survivors, as well as on some of the available information on the biology of the body, animal studies, and other evidence. The greatest risk is at high exposure levels.

- According to the National Research Council's BEIR V committee, "[t]he incidence of multiple myeloma has been observed to be elevated after widespread irradiation of the bone marrow in the majority of populations studied to date."⁹

Is Multiple Myeloma a "Specified" Cancer Under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA)?

- **Yes.** Multiple myeloma is a "specified" cancer under the EEOICPA consideration of Special Exposure Cohorts

Policy makers have identified certain types of cancer among energy employees at nuclear facilities, including those employed at Los Alamos National Laboratory, as being potentially related to occupational exposures under the EEOICPA.

What Are Other Risk Factors for Multiple Myeloma?

In considering the risks of occupational exposure to ionizing radiation leading to multiple myeloma, it is important to understand other risk factors. Below is a list of other suspected risk

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factors for multiple myeloma. Children and brothers and sisters of patients who have this disease have a slightly increased risk.

- **Hazardous chemicals.** Farmers and petroleum workers exposed to certain chemicals also seem to have a higher-than-average chance of getting multiple myeloma.

These factors may add to any risk due to workplace exposure to ionizing radiation. Most multiple myeloma patients are between 50 and 70 years old. This disease affects blacks more often than whites and men more often than women. Smoking has not been found to be related to multiple myeloma.

Rates of Multiple Myeloma in Exposed Counties

Los Alamos County

There have been moderate rates of multiple myeloma reported in Los Alamos County for both cancer incidence and mortality. Los Alamos County:

- Ranked 19th in incidence of multiple myeloma and
- 19th in mortality among the 33 counties in New Mexico from 1970 to 1996.³³
- In recent years there has been about one case per year in the county.^{13, 14}

Rio Arriba County

There have been very high rates of multiple myeloma reported in Rio Arriba County for both cancer incidence and mortality. Rio Arriba County:

- Ranked 5th highest in incidence of multiple myeloma and
- Highest in mortality among the 33 counties in New Mexico from 1970 to 1996.³³

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