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Low Level Radiation Health Effects Data

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By

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Abstract

The purpose of this IQP was to retrieve and cite references related to the positive effects of low-level radiation on human health, in order to produce summaries for the WPI CNTS website with these socially important references. I retrieved extensive literature sources in order to assess and properly reference scientific papers maintained on the CNTS website, in the low level radiation health effects science database. The subject literature sources were primarily 10 to 40 years old which are not available in electronic sources. In addition, the Massachusetts teacher's packet was reviewed for pertinent content to the site. Included are the recommendations on which topics related to low-level radiation health effects should be included for high school students.

Authorship Page

This statement acknowledges that Eric J. McCaffrey is the sole author to all sections of this report. In addition, I carried out each step necessary for the successful completion of the following report. I conducted the research required for the report without help from any outside source.

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Professor Jim Muckerheide

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- The University Of Massachusetts Medical School Library for use of its facilities

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Executive Summary

The CNTS website at Worcester Polytechnic Institute consists of a very extensive collection of journal articles concerning the positive biological effects of low dose radiation. The professionally written journals include references to material previously unavailable to the general public. A list was generated to retrieve the pertinent materials only available through the medical community. Once the reference list was generated, I used the University of Massachusetts Medical School Library to attain the periodicals required. The reference list included approximately 250 periodicals ranging from 2 pages to 30 pages per periodical. The periodicals were then copied using the onsite Xerox copy machine. In addition to the references, the Massachusetts Teachers Packet for Radiation was reviewed, and analyzed for pertinent information to the website.

Project Purpose

The purpose of this project was to attain and cite references related to the positive health effects of low level radiation, in the future to create a summary of the articles, and to post that information in an organized fashion on. The project also included the review of the Massachusetts teacher packet for its educational benefit and the feasibility of using it as an internet source. The overall purpose of the project was to attain and organize data to reinforce the ideas set forth on the CNTS website. The lack of knowledge in the affairs of low level radiation for the general public drove the need to create a comprehensive list of references from the medical community. By listing and summarizing these references on the internet, they become easily accessible by any person with questions about the biological effects of low level radiation.

Methodology

Overview

The following chart provides information regarding dose and its effect on the human body. The chart is used to show the very slowly escalating effects of radiation on human health, and to identify the small radiation exposures that occur in an individual's normal daily life. The first proven signs of any negative effects occur at a relatively large exposure of 1 rem which is far above the low doses discussed for medical use on the CNTS website.

A good example for demonstrating the need to educate the public on placing various radiation doses in proper perspective is the Three Mile Island nuclear accident. The average dose received by people within 50 miles of the Three Mile Island accident (3^{rd} row in the chart) is surprisingly only 1.5 mrems. This dose pales in comparison to the average annual dose of 180-360 mrems (10^{th} row in the chart) received in the U.S., predominately from radon gas. The hysteria created after the accident was not proportional to the extremely small dose received by the surrounding people. Surprisingly, the same people who were overly concerned with the Three Mile Island release would have no problem receiving a chest X-ray with a dose almost 6 times higher (10 mrem). The driving force behind this

project was to help attain prominent medical field data to help support the notion that low levels of radiation are not only safe to the public, but can even be beneficial to good health.

Rem Radiation Dose Chart[1]

Dose	Description
0.15 mrem	Annual dose per hour of TV watching per day.
1 mrem	Average dose for each 2500 miles traveled by air.
1.5 mrems	Average exposure to people within 50 miles of the Three Mile Island accident, the worst accident in the history of U.S. commercial nuclear power.
3 mrems	Average annual exposure from drinking water.
10 mrems	An average chest x-ray.
12-14 mrems	Maximum allowable daily dose for radioisotope workers.
27 mrems	Average annual exposure from cosmic rays.
28 mrems	Average annual exposure from the soil and rocks.
200 mrems	Average annual exposure from radon in the air. The surface exposure of 1.0 mCi of P-32 per minute.
180-360 mrems	**The annual U.S. average natural dose per person.**
500 mrems	An average gastrointestinal tract x-ray. **Maximum pre-natal exposure during the entire pregnancy**. *10-CFR-20.1208*
1 rem	Increases your chance of getting cancer by 0.03%, thus the overall risk goes from 25% to 25.03%. Equivalent to swallowing 16 mCi of H-3
5 rems	**Maximum allowable annual whole body dose for radioisotope workers.** *10-CFR-20.1201*
<25 rems	Possibly induces a lower white blood cell count.
50 rems	**Lifetime allowed limit for radioisotope workers.**
100 rems	Marked change in blood cell count. Nausea in 50% of exposed individuals.
200 rems	Nausea, vomiting, diarrhea, hair-loss, skin reddening, some internal bleeding, fatigue, increased susceptibility to infection. This is the threshold for death if not treated. Requires blood transfusions.
400 rems	LD-50-30. Causes death in 50% of the exposed population within 30 days if not treated. There are still some fatalities even with medical treatment.
600 rems	LD-100-30. Causes death in 100% of the exposed population within 30 days if not treated. Even with medical treatment, it is lethal for 50-70% of the population.
800 rems	Lethal dose for 100% of the population even with medical treatment.

[1] National Academy of Sciences, Committee on the Biological Effects of Ionizing Radiation, BEIR-III.

Section 20 References

The website of the Center for Nuclear Technology and Society at WPI is maintained by Jim Muckerheide. It includes the database on low level radiation health effects of the Radiation, Science, and Health group. See: http://cnts.wpi.edu/RSH/Docs/ and the link to the science data document database, "3rd Edition, March 2002" at: http://cnts.wpi.edu:9000/rsh/dd3/ database.jsp. A selection of reference papers from primary sources were unable to be reviewed by electronic access to PubMed and other databases because abstracts were either unavailable or inadequate. After screening, a status code in the database was identified A list was generated from the site. With the list in hand, I went to the University of Massachusetts Medical School Library. With a list of approximately 250 articles I began the process of searching and retrieving the archived references. Due to the age and in some cases obscure nature of the reference material, the process of retrieval was quite time consuming. I attained approximately 10 references at a time, and I then copied the required periodical. A large amount of time was also spent on copying due to the age of the material. When most of these articles were written and archived, the use of a

photocopy machine was not considered. It took considerable effort to attain copies of high enough quality for the CNTS website. All references dated prior to 1965 were not immediately available at the UMASS library. These periodicals need to be retrieved through the library staff, and can be available in 1 to 2 days. The periodicals attained amounted to approximately 1500 pages.

Massachusetts Teacher's Packet

The Massachusetts Teacher's Resource Packet(TRP) is provided by the State of Massachusetts to provide curriculum ideas to help assist science, life science, and social studies teachers. After an in depth review of the teacher's packet, it was determined that quite a few sections were beyond the scope of the normal high school curriculum, but several were identified of interest. The most pertinent Module to high school education is Module 3 (Biological Effects of Ionizing Radiation). Module 3 consists of 5 different learning activities:[2]

1. Radon in Your Home
2. Estimating Your Annual Radiation Dose
3. Sowing the Seeds of Controversy
4. Assessing Risk

[2] Teacher's Resource Packet, The Commonwealth of Massachusetts, (MAY, 1998) 3-1 to 3-5.

5. Factors Affecting Risk Judgment

The first learning activity is important due to its application to everyday life. The knowledge of how radon is produced and its decay chain will help students understand its importance in home construction. The activity identifies three ways to remove radon from a home, a process that may even be going on in their on homes. The second activity is extremely important in teaching students the facts about radiation dose and its effect on the human body. The activity requires the student to comprehend the amount of radiation encountered naturally. By doing this the student is more informed about their own health and its relation to radiation dose. The third activity allows the student to have a hands-on approach to the power of ionizing radiation. The seed germination lab shows students that ionizing radiation at low levels can be beneficial to life. It also may surprise students that radiation is actually necessary for life to exist. Learning activity number 4 is not limited to nuclear related risk assessment. The learning activity introduces the student to a new way of thinking about risk. It requires the student to evaluate all the types of risk we are surrounded by daily. Through risk assessment the student learns how to reduce their risk to

overexposure of large doses of ionizing radiation while at the same time it gives the student a perspective on the risks of low level radiation. Learning activity 5 is a continuation of the risk assessment discussed in section 4. The activity is important for the student grasp the idea of risk assessment, and to apply it to their own lives. Module 3 should be available, if not mandatory, to all the teachers in the state of Massachusetts. Although the state produces the packet, it does not actively distribute the packet to schools. I recommend Module 3 be readily available to all who are teaching in fields related to radiation, and recommend Module 3 be made available through the internet.

Conclusion

The conclusion of this project is that a large amount of peer-reviewed published data exists through research done over the past 50 years to convince this author that low level radiation can be beneficial to human health. The attained references are essential to properly justify the claims of the authors on the CNTS website. Without the summaries of these references the author's claims must be taken at face value. The summaries that will be created from the references will allow the reader to investigate the process that the author used to come to his or her conclusions.

The Massachusetts Teacher's Packet is available to teachers in the State of Massachusetts to assist with radiation education. It has been concluded that the packet is too extensive for the normal curriculum at the high school level. This could explain why most graduating high school students do not have a grasp of nuclear waste disposal or the building of a Disposal Facilities. The packet appears to be too specific to the nuclear community. Some of the material contained is specific to the knowledge attained by radiation workers and engineers, and may be seen as far above

the scope of any high school classroom. After review of the packet I concluded that Module 4 (Low-Level Radioactive Waste and its Management)of the packet should be removed. The module requires an in depth knowledge of the nuclear industry which most high school teachers and students do not have. I have also concluded that Module 3 (Biological Effects of Ionizing Radiation) should be the primary objective of the educator. If a teacher were to only touch upon one subject in the nuclear field, it should be Module 3, as explained in this report.

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