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FACTS CONCERNING RADIATION

The Human Research Protection Office (HRPO), the Radioactive Drug Research Committee, and the Radiation Safety Committee of Washington University School of Medicine have prepared this brochure to provide you with additional information that may help you to decide whether or not you wish to participate in a research study that involves radiation exposure. Misconceptions about the hazards of radiation are common. In general, most individuals perceive the risks of radiation to be greater than the actual risks. Therefore, most people will find the information contained in these pages reassuring. However, remember that your participation in any research study is voluntary. The information in this brochure is not intended to convince you to participate in a research study if you do not wish to do so.

When assessing the risks of radiation, you may want to consider three facts. First, we are all exposed to small amounts of radiation from natural sources throughout our lives. This natural radiation comes from cosmic rays and from naturally occurring radioactive atoms in the earth and in our atmosphere. In the United States, the average annual radiation exposure to each person from these natural sources is about 300 millirem. (The rem is the unit used to measure radiation exposure; 1 rem = 1,000 millirem.) Second, the effects of radiation have been extensively studied. Although physicians and scientists do not understand everything about the effects of radiation, we know more about radiation than we do about many other hazards, such as chemical pollutants. Third, the potential harmful effects of radiation are dependent on the amount and type of radiation. Large amounts of radiation (exposures of greater than 20,000 millirem over a few seconds) can have measurable long-term damaging effects. Small amounts of radiation exposure (less than 10,000 millirem) have not been clearly shown to have harmful effects. The amount of radiation that you would be exposed to in this study is less than the amount that is known to cause a measurable harmful effect.

Numerous studies have tried to measure the harmful effects of small amounts of radiation directly. Despite the fact that these studies have not demonstrated any measurable harmful effects of small amounts of radiation, it is generally assumed that the effects of radiation are related to the amount of radiation. In other words, it is assumed that if a large amount of radiation has a large chance of producing a harmful effect, then a small amount of radiation will have a small chance of producing a harmful effect. This assumption probably overestimates the effects of small amounts of radiation because it ignores the fact that the body can repair the damage done by radiation if the repair mechanisms are not overwhelmed.

If we ignore the body's repair mechanisms and assume that the effects of small amounts of radiation are proportionately related to the effects of large amounts of radiation, we can estimate how likely it is that you will have a harmful effect from being exposed to small amounts of radiation. Large amounts of radiation clearly increase the risk of developing cancer. One widely used estimate of this risk is that repeated exposure to small amounts of radiation will cause about 400 fatal cancers in a group of one million people who are each exposed to 1,000 millirem of radiation. The risk is 2 to 3 times greater in younger adults than in older adults. One way of putting this into perspective is to compare the risk of developing cancer from radiation. In the United States, the overall lifetime risk of fatal cancer is about 28%. Therefore, in a group of one million people, there will be 280,000 fatal cancers from natural causes. Since radiation-induced cancers do not occur until many years after the radiation exposure, and since it is impossible to tell whether or not a particular cancer is due to radiation, it is impossible to measure this slight increase (from 200,000 to 200,400) in the cancer risk. It is important to realize that if a cancer does develop in an individual after he or she was exposed to radiation, it is much more likely that the cancer occurred naturally than that it was due to the radiation exposure.

A second effect of radiation that is often discussed is the effect on genes. Although genetic effects have been observed in animals, they have not been observed in humans. They probably do occur in humans but the effect has been too small to measure directly. For example, genetic abnormalities have been carefully looked for in the children of the 85,000 survivors of the atomic bombings at Hiroshima and Nagasaki. No increase in genetic abnormalities has been observed. Obviously, genetic effects are only important in people who are planning to have more children.

One way to better understand the radiation risk of participating in a research study involving radiation is to compare the amount of radiation from the research study to other sources of radiation. For example, as noted above, naturally occurring radiation exposes each of us to 300 millirems of radiation in each year. In an average lifetime (75 years), each person will be exposed to a total of 22,500 millirem of radiation from natural sources alone. Common x-ray procedures, which you may have already had for diagnostic purposes, will expose patients to radiation in amounts ranging from as little as 10 millirem to 10,000 millirem or more. Radiation workers (for example, x-ray technologists) are allowed a maximum yearly exposure of 5,000 millirem. Over their working lifetime (40 years) they may be exposed to 100,000 to 200,000 millirem. Although these levels of radiation are assumed to cause an increased risk of cancer, follow-up studies in radiation workers have rarely shown any measurable increase in the risk of cancer.

The last issue that we will address is the cumulative effects of radiation exposure. During their lifetimes, some people have many diagnostic tests involving radiation exposure or may participate in multiple research studies that result in additional radiation exposure. Assessing the risk and benefits of diagnostic and research radiation should be done separately. When diagnostic tests involving radiation are clearly indicated, the benefit from having the tests (obtaining a better understanding of your disease) almost always outweighs the risks from the radiation exposure by a large amount. For this reason there is no real limit to the amount of radiation exposure you can have from diagnostic tests when they are clearly indicated as part of your medical care. When you participate in a research study, it is likely that you will receive no direct medical benefit. Ultimately, it is hoped that society will reap the benefits from the research. When you will receive no direct benefit from the radiation exposure, you should limit your radiation exposure to less than 5,000 millirem per year. For this reason, you should let the investigator know if you are participating in other research projects involving radiation. When a research study is likely to provide some direct benefit to the participants, radiation doses of greater than 5,000 millirem may be permitted.

We hope that the information provided in this brochure has been helpful. If you have additional questions regarding the effects of radiation, you should ask the investigator or you may contact Dr. Henry Royal or Dr. Barry Siegel in the University's Division of Nuclear Medicine (314-362-2809).

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