Dose-Response: An International Journal

Volume 9 | Issue 1 Article 3

3-2011

EDITORIAL: IS AIRPORT BODY-SCAN RADIATION A HEALTH RISK?

Jerry M. Cuttler

Cuttler and Associates, Inc., Mississauga, ON, Canada

Dose-Response, 9:1–5, 2011
Formerly Nonlinearity in Biology, Toxicology, and Medicine

ISSN: 1559-3258
DOI: 10.2203/dose-response.10-047.Cuttler

International Dose-Response Society
www.Dose-Response.org

EDITORIAL: IS AIRPORT BODY-SCAN RADIATION A HEALTH RISK?

Jerry M. Cuttler □ Cuttler & Associates Inc., Mississauga, ON, Canada

> *History will remember the inhabitants of this (20th) century as the people who went from Kitty Hawk to the moon in 66 years, only to languish for the next 30 years in low Earth orbit. At the core of the risk-free society is a self-indulgent failure of nerve.*
>
> *—Buzz Aldrin, Apollo 11 astronaut*

The USA is under attack by an ideologically-driven enemy who cleverly exploits vulnerabilities in America's free society to inflict national suffering and fear. One such area is the enormous volume of airline travel. It is still an easy target, in spite of the elaborate procedures and the advanced technologies that have been employed over the years to detect highjackers and suicide bombers at the many congested airports. Luggage has been x-rayed for decades, and now passengers.

Passengers who complained about long delays and objected to careful body searches are now challenged by their fear of receiving a very mild dose of x-rays. Even medical practitioners and scientists who should know better are expressing concerns about risks of cancers and congenital malformations and about harm to a fetus.

X-rays were discovered 115 years ago by Wilhelm Roentgen and have been applied ever since on humans and a very wide variety of other biological organisms in countless research studies, diagnostic procedures and medical treatments. The doses and dose rates have ranged from the lowest possible to highly lethal levels. All organisms, since the beginning of life on Earth, have been exposed to the ubiquitous sea of natural radioactivity and cosmic radiation. As a result of our extensive studies and experience, we know more about the effects of ionizing radiation on health than any other perturbing agent or substance. Many radiobiologists understand how a low dose or a low chronic dose rate can stimulate protective processes in cells, tissues, and organs leading to improved health and that a high dose delivered at a high dose rate can inhibit natural defenses leading to morbidity and loss of life (UNSCEAR 1994; Edwards and Lloyd 1996; Tubiana *et al.* 2005).

Address correspondence to Jerry M. Cuttler, Cuttler & Associates Inc., Mississauga, ON, Canada. Email: jerrycuttler@rogers.com

The ionizing radiation dose chart in Figure 1 (Metting 2010) although not intended to be highly accurate is an excellent reflection of some of the scientific knowledge developed over the past century. The dose range spans more than six orders of magnitude. The low doses relate to medical diagnostics and to the radiation regulations and guidelines. The moderate doses pertain to space travel, the atomic bomb survivors and cancer epidemiology; the high doses to the acute radiation syndromes and to cancer radiotherapy.

Over the past forty years, many researchers have been studying important and in some cases novel bio-positive effects occurring in the range from 1 to 100 mSv when exposure is brief and over a much wider dose range when exposure is protracted (Luckey 1991; Wolf 1992; Sakai *et al.* 2003; Tubiana *et al.* 2005; Bauer 2007; Day *et al.* 2007; Feinendegen et al 2007; Liu 2007; Ogura *et al.* 2009).

Based upon human data, a single whole-body dose of 150 mSv (15 rem) is safe. The high natural radiation level of 700 mSv per year (70 rem/year), corresponding to a 70-year lifetime dose of 49 Sv in Ramsar, Iran, is also safe. Both these single and continuous doses are also beneficial (Cuttler and Pollycove 2009). This conclusion is applicable to humans of all ages and to sensitive, cancer-prone individuals.

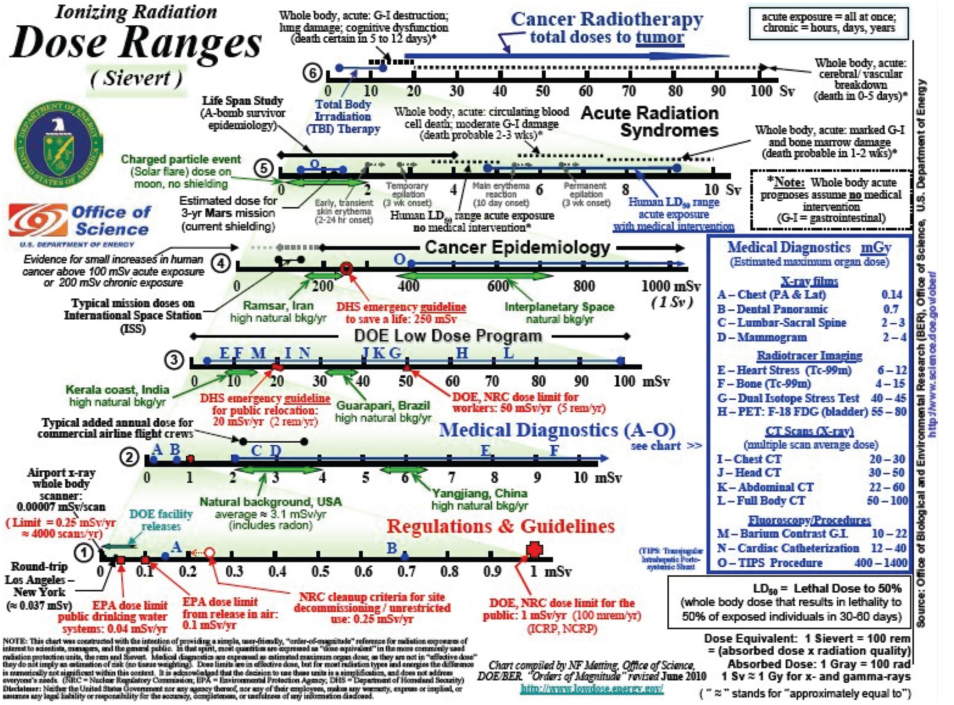

FIGURE 1. Ionizing Radiation Dose Ranges (Metting 2010)

Airport Body-Scan Radiation

The whole-body airport scanner employed by the U.S. Transportation Security Administration is based on an advanced imaging technology, which measures x-rays that are Compton scattered back from the surface of the passenger's body (JHU-APL 2010). Each scan takes a few seconds and irradiates a passenger with a low energy (28 kilovolt) dose of about 5 microrem (HPS 2010) or 0.05 microSv. It is three million times smaller than the safe dose of 150 mSv. How can there be any concern about possible adverse health effect? There certainly is an enormous margin to increase the dose for improved scan penetration or image quality, if required.

To understand the pervasive radiation phobia, we need to consider its origin. During the first half of the 20th century, the hazardous aspects of ionizing radiation were controlled by defining a safe limit for occupational exposures—mainly radiologists. The limit set in 1934 was 0.2 rads per day (2 mSv/day for x-rays); it was lowered in 1951 to 0.3 rads per week (or 156 mSv/year). The whole approach changed after the use of nuclear weapons to end World War II and the start of the nuclear arms race with the development, testing and production of larger and larger bombs. Strong political opposition arose against this military build-up. Related to this were thoughts about the consequences of radiation-induced damage in the cells of living organisms. Studies had been carried out on the mutation of cells in fruit flies caused by x-rays. By 1955, the safe threshold concept was arbitrarily rejected by the International Commission on Radiological Protection (ICRP) and the concept of linear no-threshold (LNT) cancer and genetic risks was accepted instead. According to this assumption, even a near-zero dose of radiation can be harmful. The science of radiation biology had thus become politicized, and with this came a very heavy economic burden of regulatory scrutiny and licensing on all the users of radiation-emitting equipment and substances.

In this new approach, a graph of excess cancer mortality versus radiation dose can be drawn for the Life Span Study cohort of the Hiroshima and Nagasaki bombing survivors. (There have been a few hundred deaths from cancer, in excess of the expected number, in the ~ 87,000 cohort.) Below a dose of about 500 mSv, the statistics are very poor. Nevertheless, a risk of excess cancer is assigned throughout the low dose range by extending a straight line from the data above 1000 mSv to zero dose. This is the LNT assumption of radiation carcinogenesis. In spite of countless and repeated studies designed to find risk, there is no statistically significant evidence of a cancer risk below a dose 100 mSv. The extensive evidence of beneficial effects in this range is disregarded or concealed (Cuttler 2010; Jaworowski 2010).

In 1959, in its first publication, the ICRP introduced for the first time a dose limit for the general population, based on LNT. Its value of 5 mSv per year was then decreased in 1990 to 1 mSv per year. This level is about

three orders of magnitude below natural radiation doses received by people living in several high natural radiation areas, where no adverse radiation effects were ever observed.

Dr. Roger Clarke, then chairman of the ICRP, stated in 2001 (Clarke 2001): "Since no radiation level higher than natural background can be regarded as absolutely 'safe,' the problem is to choose a practical level that, in the light of present knowledge, involves negligible risk." However, the ICRP has not followed this principle.

From early childhood, people have been carefully taught that ionizing radiation is dangerous and this delusion of risk has become ingrained as a "meme" over the past 50 years. It is the basis for the on-going phobia and ostensibly authoritative statements, such as, "no amount of radiation is small enough to be harmless." Radiobiologists have been studying radiation effects for more than a century, but their scientific evidence of no harm or improved health is being ignored or rejected because of the adverse indoctrination. Perhaps the social pressure to continue improving air travel security without undue hassle will lead to social awareness and acceptance of the many benefits of ionizing radiation.

REFERENCES

Bauer G. 2007. Low Dose Radiation and Intercellular Induction of Apoptosis: Potential Implications for Control of Oncogenesis. *Int J Radiat Biol* 83: 873-888

Clarke RH. 2001. Progress Towards New Recommendations from the International Commission on Radiological Protection. *Nuclear Energy* 40(1): 37-45

Cuttler JM and Pollycove M. 2009. Nuclear Energy and Health: And the Benefits of Low-Dose Radiation Hormesis. *Dose-Response* 7(1): 52-89. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2664640/

Cuttler JM. 2010. Commentary on Using LNT for Radiation Protection and Risk Assessment. *Dose-Response* 8(3): 378–383. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2939692/

Day T, Zeng G, Hooker A, Bhat M, Scott BR, Turner DR and Sykes PJ. 2007. Adaptive Response for Chromosomal Inversions in pKZ1 Mouse Prostate Induced by Low Doses of X Radiation Delivered after a High Dose. *Radiat Res* 167: 682-692

Edwards AA and Lloyd DC. 1996. Risks from Deterministic Effects of Ionising Radiation. National Radiological Protection Board. Chilton. UK. Report 7(3): 1-31

Feinendegen L, Pollycove M and Neumann RD. 2007. Whole-Body Responses to Low-Level Radiation Exposure: New Concepts in Mammalian Radiobiology. *Experim Hematol* 35: 37-46

HPS 2010. X-Ray Security Screening of People. Health Physics Society. Publications. Available at: http://hps.org/documents/wholebodyscanners.pdf

Jaworowski Z. 2010. Observations on the Chernobyl Disaster and LNT. *Dose-Response* 8(2): 148-171. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2889503/

JHU-APL 2010. Radiation Safety Engineering Assessment Report for the Rapiscan Secure 1000 in Single Pose Configuration. Version 2.0. NSTD-09-1085. August 2010. The Johns Hopkins University. Applied Physics Laboratory. Available at: http://www.tsa.gov/assets/pdf/jh-apl-v2.pdf

Liu S-Z. 2007. Cancer Control Related to Stimulation of Immunity by Low-Dose Radiation. *Dose-Response* 5: 39-47

Luckey TD. 1991. Radiation Hormesis. CRC Press

Metting N. 2010. Ionizing Radiation Dose Ranges (Sievert). U.S. Department of Energy. Office of Science. Office of Biological and Environmental Research. Available at: http://www.remm.nlm.gov/DOE_PosterShowingRadiationDoses_Part2.pdf

Ogura K, Magae J, Kawakami Y and Koana T. 2009. Reduction in Mutation Frequency by Very Low-Dose Gamma Irradiation of Drosophilia Melanogaster Germ Cells. *Radiat Res* 171: 1-8

Sakai K, Hoshi Y, Nomura T, Oda T, Iwasaki T, Fujita K, Yamada T and Tanooka H. 2003. Suppression of Carcinogenic Process in Mice by Chronic Low Dose Rate Gamma-Irradiation. *Int J Low Radiat* 1(1): 142-146

Tubiana M, Aurengo A, Averbeck D, Bonnin A, Le Gruen B, Masse R, Monier R, Valleron A-J and de Vathaire R. eds. 2005. Dose-Effect Relationships and the Estimation of the Carcinogenic Effects of Low Doses of Ionizing Radiation. Academy of Medicine (Paris) and Academy of Science (Paris). Joint Report No. 2

UNSCEAR. 1994. Annex B. Adaptive Response to Radiation in Cells and Organisms. United Nations Scientific Committee on the Effects of Atomic Radiations. Sources and Effects of Ionizing Radiation. Report to the General Assembly with Scientific Annexes. New York. Annex B: 185-272

Wolf S. 1992. Failla Memorial Lecture. Is Radiation All Bad? The Search for Adaptation. *Radiat Res* 131: 117-123