

What is the Situation Regarding Low Dose and Low Dose-Rate Ionizing Radiation in the USA?

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Significance of this research in the USA

Environmental clean-up – Hanford (>\$110 Billion to date)

Nuclear Accidents – Fukushima (160,000 evacuated, 20 mGy/yr)

Rad worker exposures, individuals (children) in adjacent areas

Flight Crews and Astronauts (limits to the Mars mission?)

Potential Terrorist Attacks (nuclear power plants, dirty bombs, RDD's, IND's). Interacting with exposed survivors

Security issues (backscatter machines for screening)

Medical Diagnostics: ~90 million CT scans annually(5-100 mSv)

Acute exposure v protracted exposure (low dose rate)



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Programs Funded By the DOE Low Dose Radiation Research Program 2008

45 Institutions, some with multiple awards.

Columbia University	Medical College of Georgia	Thomas Jefferson University	Medical Research Council, UK
New Jersey Medical School	University of Chicago	University of Utah	Queen's Univeristy, UK
Colorado State University	University of California, Riverside	Northwestern University	Childrens Hospital, Okland, Ca
University of Colorado	University of California, Irvine	Pacific Northwest National Laboratory	Memorial Sloan Kettering Cancer Center
Harvard University	University of California, San Francisco	Los Alamos National Laboratory	National Taiwan University
University of Texas	University of Massachusetts	Brookhaven National Laboratory	University of Lethbridge, Canada
Case Western University	Loma Linda University	Lawrence Berkeley National Laboratory	McMaster University, Canada
University of California Berkeley	Duke University	Lawrence Livermore National Laboratory	Simons Cancer Center
Washington State University, Tricities	University of Tennessee	Oak Ridge National Laboratory	High Throughput Genomics
University of North Carolina	Purdue University	NASA Johnson Space Center	Flinders University, Australia
University of Texas, Galveston	University of Rochester	Health Protection Agency, UK	
Texas Southern University	University of Maryland		
Texas A &M University	University of Iowa		

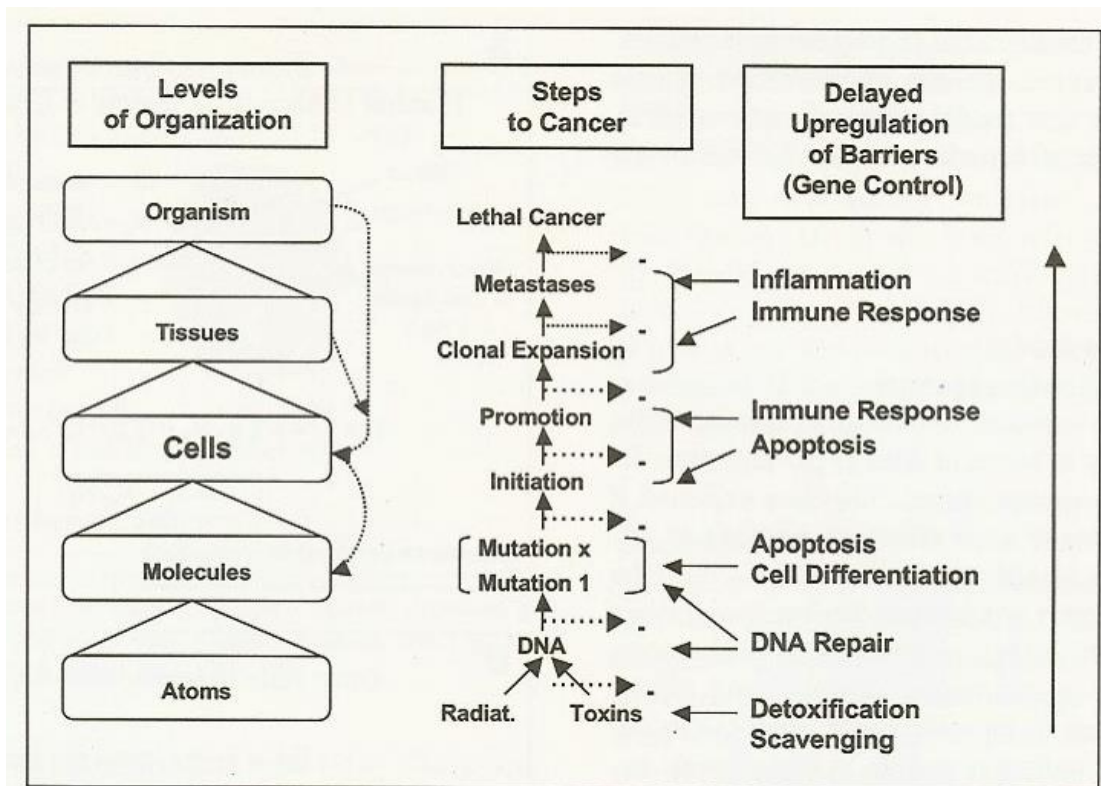


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Significance of this research

Basic studies of biological response(s) to ionizing radiation at low doses, including the further development of experimental approaches will permit a better understand of the biological process that underpin health effects and the potential mechanism(s) for the epidemiological data.



Specific Questions Addressed

Are the mechanisms of action the same for low and high doses of radiation?

Do we need to change current paradigms in radiation biology - non-targeted effects?

Is the LNT hypothesis an accurate scientific description for the dose-response relationship for cancer in the low dose region?

How do non-targeted effects influence cancer and non-cancer risks (cardiovascular and cataracts) after irradiation?



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Congressional action, 2015 - ?

113TH CONGRESS 2D SESSION H. R. 5544

To increase the understanding of the health effects of low doses of ionizing radiation.

IN THE HOUSE OF REPRESENTATIVES

SEPTEMBER 18, 2014

IN GENERAL. The Director of the Department of Energy Office of Science shall carry out a research program on low dose radiation. The purpose of the program is to enhance the scientific understanding of and reduce uncertainties associated with the effects of exposure to low dose radiation in order to inform improved risk management methods.

I hope its not too little too late!



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In terms of our task today, scoping a potential BEIR VIII report, premature in terms of new information on low dose radiation effects.

ICRP 99 (2005), page 112

(264) When considered as a whole, the emerging results with regard to a radiation-related adaptive response, genomic instability, and bystander effects suggest that the risk of low-level exposure to IR is uncertain, and a simple extrapolation from high-dose effects may not be wholly justified in all instances. However, a better understanding of the mechanisms for these phenomena, the extent to which they are active in vivo, and how they are inter-related is needed before they can be evaluated as factors to be included in the estimation of potential risk to the human population of exposure to low levels of IR. It should be recognised that information from direct epidemiological measure of cancer risk will, by definition, include any potential contribution from these mechanistic processes, and may therefore provide insights about them, subject to the constraints of low statistical power at low doses.

Million worker study [Boice](#)

DREF, DDREF report [ICRP TG 91](#)



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Widespread support and a clear rationale for continued low dose radiation research.

ICRP recognizes a need for more research so better radiation protection guidelines can be established. [Morgan to Co-Chair committee](#)

NCRP - National Crisis: Where Are the Radiation Professionals (WARP)?
[Meeting held July 17, 2013; and conclusions published in Health Physics.](#)

Gaps in our knowledge seriously impact our ability to make science-driven decisions after a large-scale radiological event with potentially major health and economic consequences. [Brenner: Congressional briefing.](#)

“This is a critical time for the radiation sciences and the implications of future research will have a significant impact on radiation protection, medicine, national security, research and industry”. [Morgan and Bair: Radiation Research 179, 501–510 \(2013\)*](#)

USA no longer a leader or innovator in this research field

Significant areas of controversy remain, LNT, hormesis, DREF etc.

- ▶ ICRP recommends a DDREF of 2.0
- ▶ BEIR VII recommended a DDREF of 1.5
- ▶ Many considering a DDREF of 1.0



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DOSE RATE EFFECTS

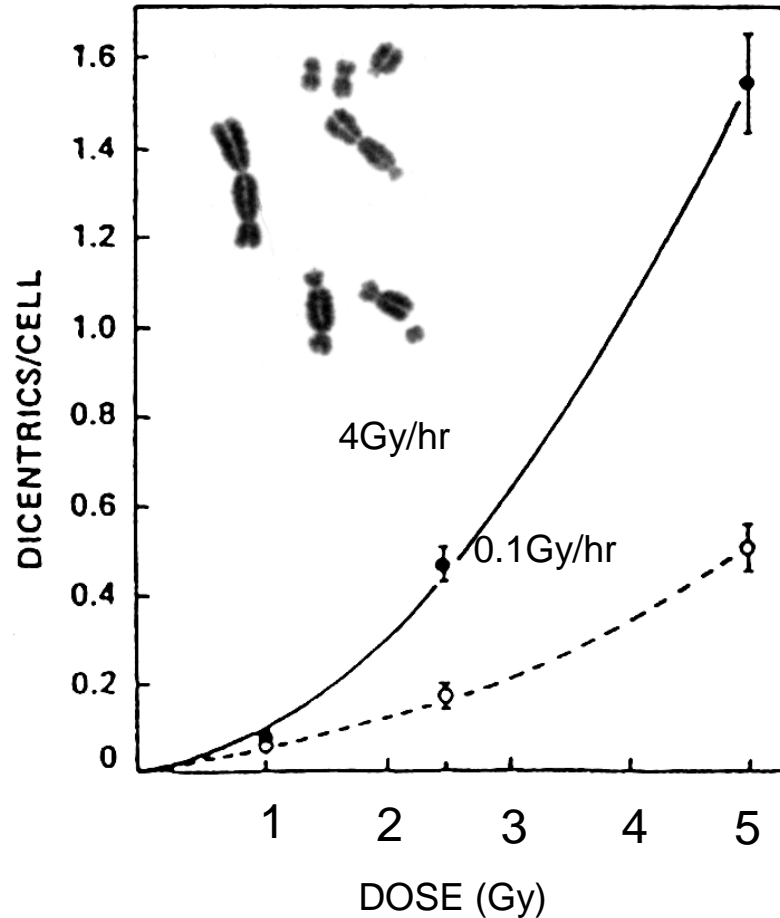
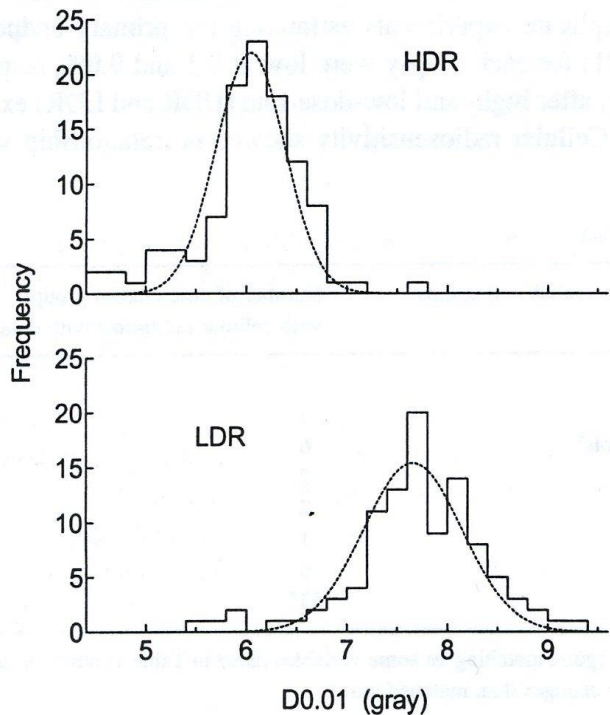


Fig. 1. Frequency distribution of fibroblast radiosensitivity (expressed as D0.01) after HDR or LDR irradiation.

Peacock et al., *Radiother. Oncol.* 55, 173-8 (2000)

Radiobiology a clear DREF, epidemiology yes & no

Animal studies a huge DREF, Brooks et al., *Health Phys.* 97, 485-69 (2009)

Germany: DREF = unity, EU??



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ICRP TG 91: Radiation Risk Inference at Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes

Chair: Werner Ruhm, C1 (Germany)

Members

Tamara Azizova, C1 (Southern Urals)

Simon Bouffler, C1 (UK)

Roy Shore (former C1, Japan)

Gayle Woloschak (USA)

Corresponding members

Bernd Grosche (Germany)

Kaz Sakai, C5 (Japan)

Quanfu Sun, C1 (China)

Consultant

Abel Gonzalez (Argentina)

Impact on ICRP recommendations – detriment!



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What is the rest of the world doing?

20 year program
 MELODI*
 Subprogram, e.g.
 EpiRadBio**
 CardioRisk Store
 DoReMi*
 Members of the EAB
www.hleg.de/

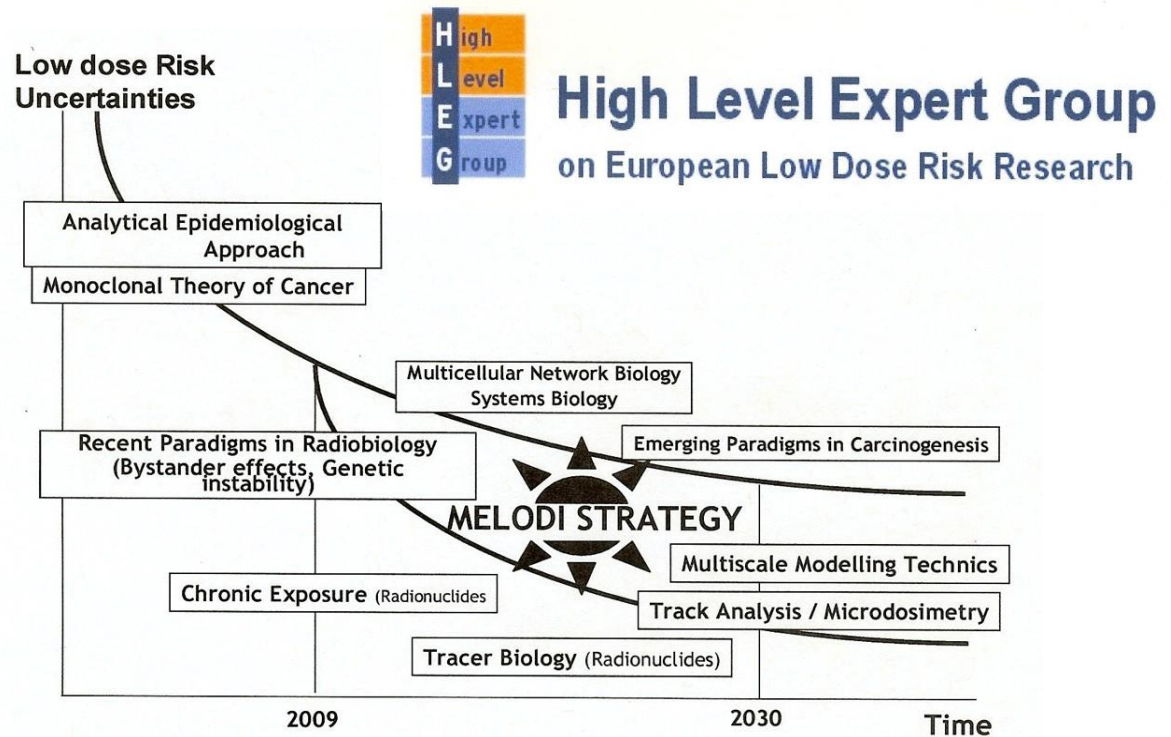


Figure 8: A new holistic approach to accelerate over 20 years the reduction of uncertainties in the understanding of low dose risks.

Japan, India and Korea – vibrant new low dose radiation programs

DOE Low Dose Radiation Research Program had a 10 year head start.
 Now falling behind technically, competitively and in competence.

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Comments and Questions:

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