Coping with Low-Dose Radiation in Fukushima

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Disclaimer: Opinions expressed in this presentation are my own professional opinion, and do not necessarily represent those of my employer.

Superstitions vs. Science

Superstition

- A belief or practice resulting from ignorance, fear of the unknown, or a false conception of causation
- A notion maintained despite evidence to the contrary

- Merriam-Webster Dictionary

Science

Study of different proposed hypotheses to determine the one that is consistent with evidence. This becomes the validated hypothesis.

Belief in science (or scientific belief) is belief in the validated hypotheses.

Science

A validated hypothesis is not determined by majority vote among scientists, volume of publications, consensus, or expert committees.

Evidence is the final arbiter.

Evidence is King.

What are the consequences of following these two approaches, superstitions vs. science?

Superstitions,
Superstitious Beliefs
and Practices

Lead to inconveniences
with no benefit,
but sometimes,
deadly consequences.

Science,
Scientific Beliefs and
Practices

Improve likelihood
for good outcomes,
based on available
knowledge

It is therefore important to eliminate superstitions, superstitious beliefs and practices, in order to reduce the chance for bad outcomes and improve the likelihood of good outcomes.

A few points regarding the practice of Science

- Sometimes there are errors in evidence, hence errors in the set of the validated hypotheses, and so errors in scientific beliefs.
- When evidence contradicts a formerly validated hypothesis, we should re-examine the past for faulty evidence, and if justified, reject the formerly validated hypothesis.

This is the self-correcting nature of science,

making it very powerful.

Calamity in Fukushima

Nuclear reactor accidents in Fukushima following the 2011 earthquake and tsunami had calamitous consequences:

Residents evacuated - led to evacuation-related deaths

→ immediate deaths of hospital patients

Prolongation of evacuation →

→ Increased deaths of elderly in nursing homes

→ Increased stress, suicides and divorces

→ Local economy destroyed

However,

No radiation-related deaths.

Main reason for the evacuation - concerns about cancers from the increased background radiation.

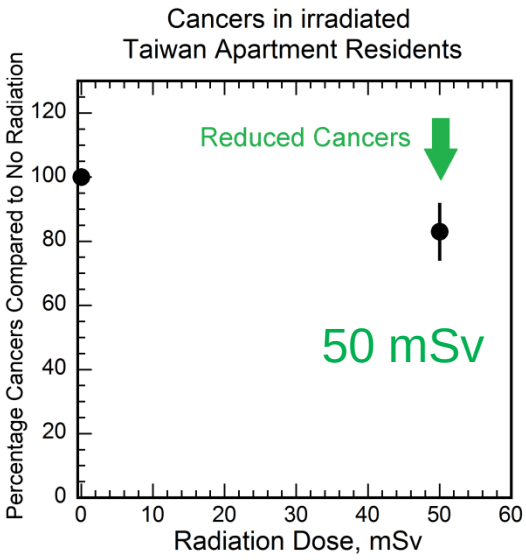
How many cancers did the evacuation prevent?

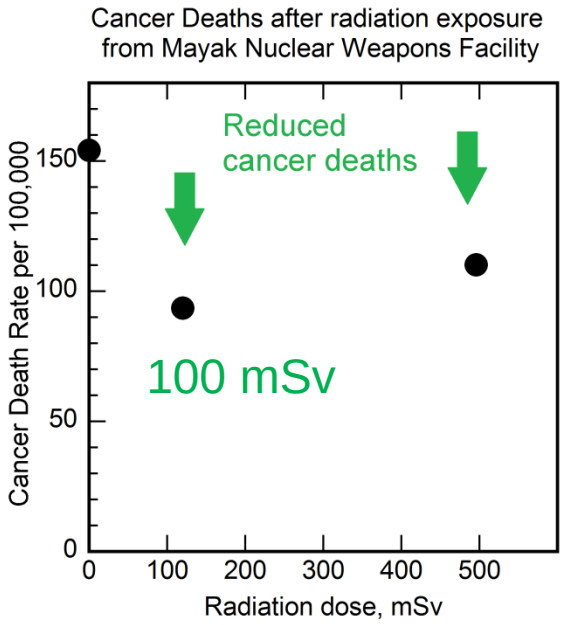
How do we estimate the number of cancers prevented by evacuation, i.e. the effect of increased background radiation on cancers?

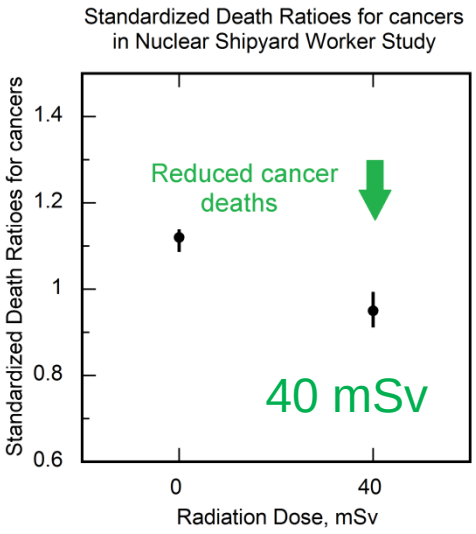
How do we estimate the number of cancers prevented by evacuation, i.e. the effect of increased background radiation on cancers?

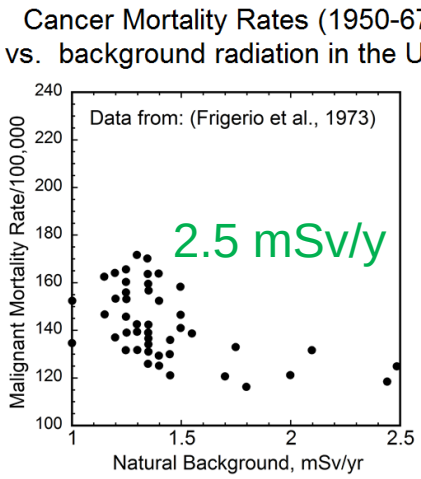
Examine the data.

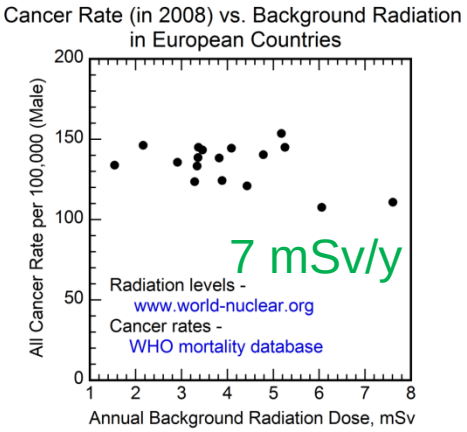
Cancer risk in populations exposed to increased background levels of radiation











According to (UNSCEAR 2013) report, maximum dose averted due to evacuation over the past 4 years was ~70 mSv.

The government did not use data (e.g. on the last slide) to estimate how the increased background radiation levels would affect cancer rates.

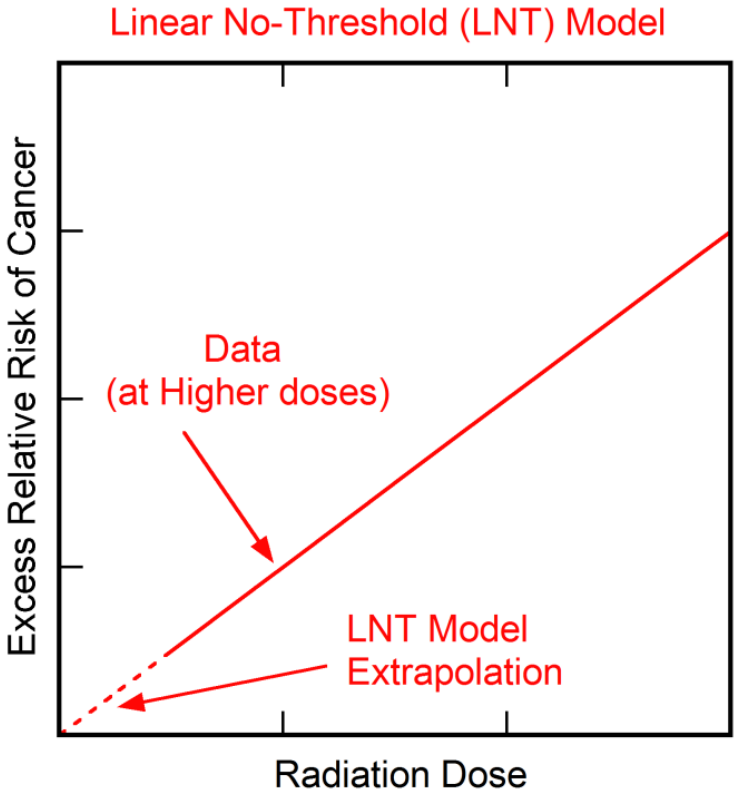
Instead, guided by advisory bodies,
they used the

Linear no-threshold (LNT) Model

to estimate the effect of
increased background radiation on cancers.

What is the Linear no-threshold Model?

The Linear no-Threshold (LNT) Model



Excess relative risk (ERR) of cancer = $\frac{R-N}{N}$

(N is the normal cancer rate,
R is the cancer rate after radiation exposure.)

Does it make sense to extrapolate the effect of radiation (or any other agent) from high levels to low levels?

Do these types of extrapolations make sense?

To determine the effect of	Extrapolate from the effect of
1 sleeping pill	Taking 100 sleeping pills
1 cm of rain in a day	100 cm of rain in a day
Applying warm water bottle to an aching joint	Applying boiling water to an aching joint
Applying cold pack to injured area to reduce pain	Applying liquid nitrogen to injured area
Hugging a baby	A bear hugging the baby
A gentle massage	Being pushed by an elephant
Drinking a cup of water	Drinking buckets of water
Jumping from a step	Jumping from top of building

No. Absolutely Not.

These types of extrapolations don't make sense.

To determine the effect of	Extrapolate from the effect of
1 sleeping pill	Taking 100 sleeping pills
1 cm of rain in a day	100 cm of rain in a day
Applying warm water bottle to an aching joint	Applying boiling water to an aching joint
Applying cold pack to injured area to reduce pain	Applying liquid nitrogen to injured area
Hugging a baby	A bear hugging the baby
A gentle massage	Being pushed by an elephant
Drinking a cup of water	Drinking buckets of water
Jumping from a step	Jumping from top of building

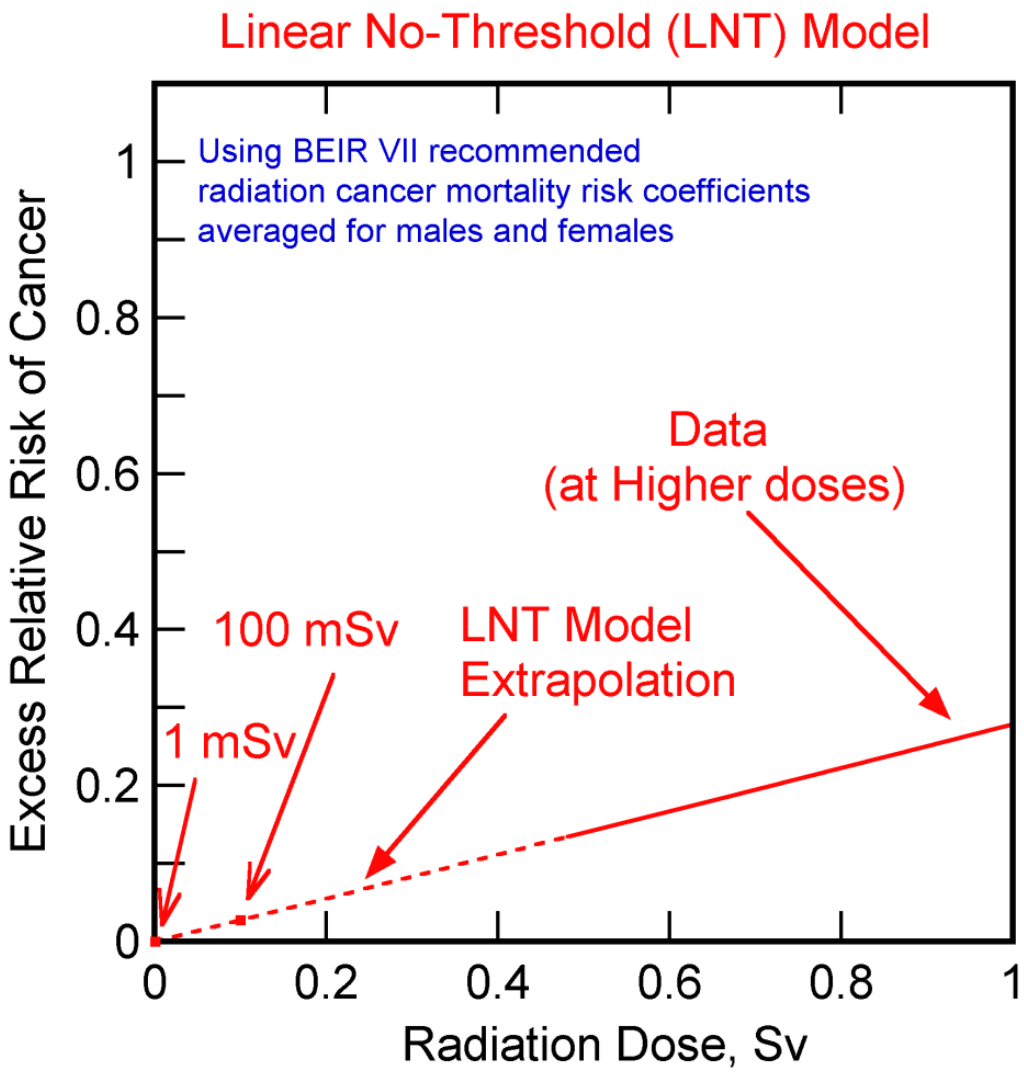
In a similar manner, for radiation,

this type of extrapolation does not make sense.

To determine the effect of	Extrapolate from
1 mSv radiation dose	1 Sv radiation dose

LNT model is senseless

LNT Model Graph

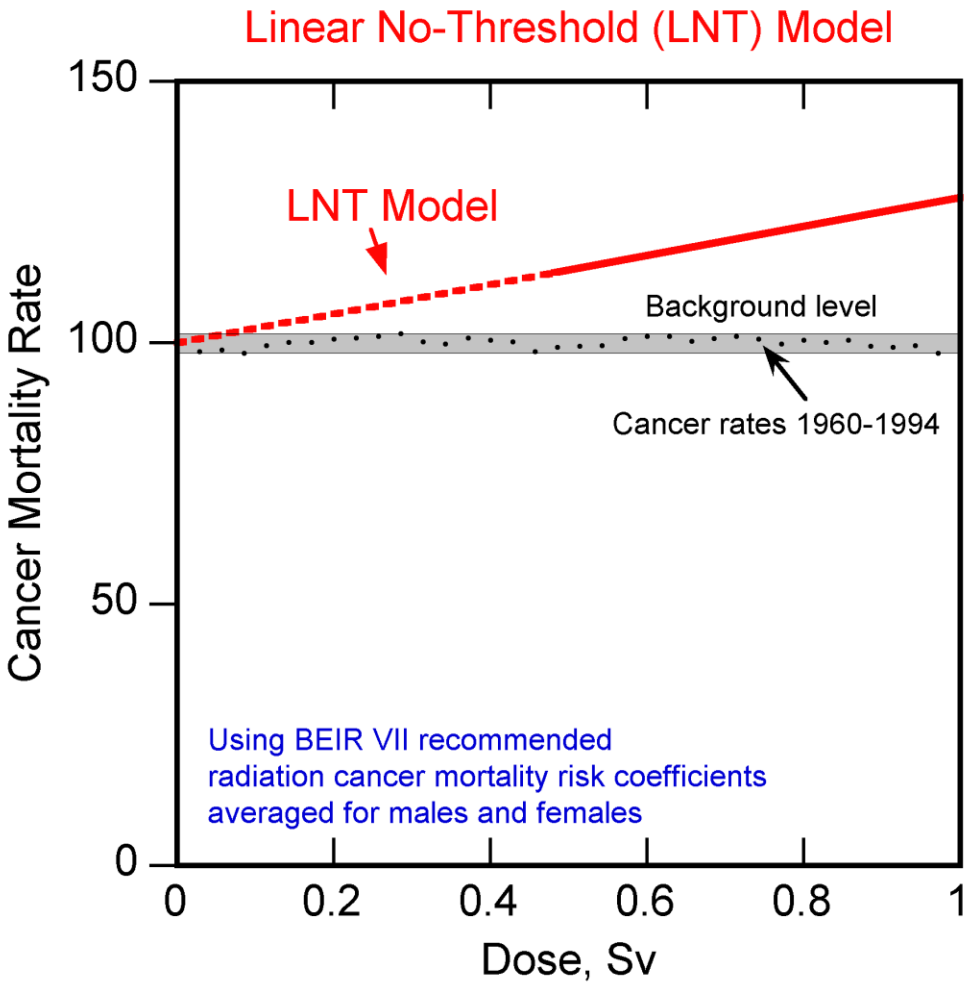


Note: This graph hides the large background level of cancers which is a major health issue (This is like hiding a big mountain)

Also hides the variation in background cancer rates from year-to-year, causing fear from the smallest claimed increase in cancer using the LNT model. (This is making a mountain out of a molehill)

A more informative way of showing the health impact of low-dose radiation based on the LNT Model is to graph the Cancer Rates rather than Excess Relative Risk

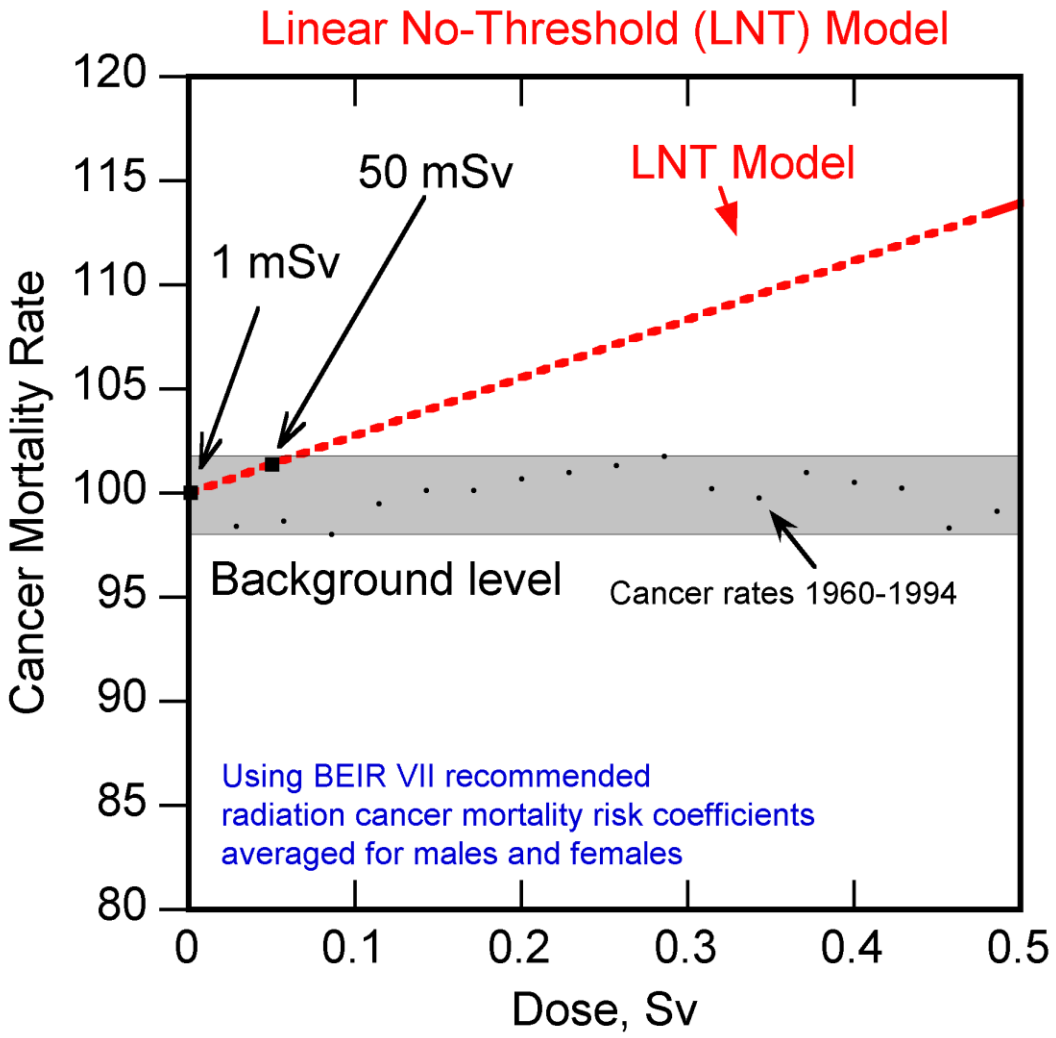
Effect of low-dose radiation on cancer mortality rate (using the LNT Model)



Does not hide the major health problem – the high background cancer rate

Shows the tiny claimed increase in cancers at low doses are not significant, due to variation in background cancer rates

Effect of low-dose radiation on cancer mortality rate (using the LNT Model)



Dose reduction efforts
50 mSv down to 1 mSv
- cancer rate within grey area
- a total waste of resources
- no health benefit.

Of course, wasted resource for the public are $$$$$ for the LNT model proponents and the resulting businesses.

Benefit to public: ZERO
Cost to the public:

Enormous

If a drug manufacturer said their drug would reduce cancers by 2%, would we pay them big bucks for the drug?

Obviously No.

Should our society support the tremendous expenses based on the LNT Model that would produce similar reduction in cancers assuming the model is valid?

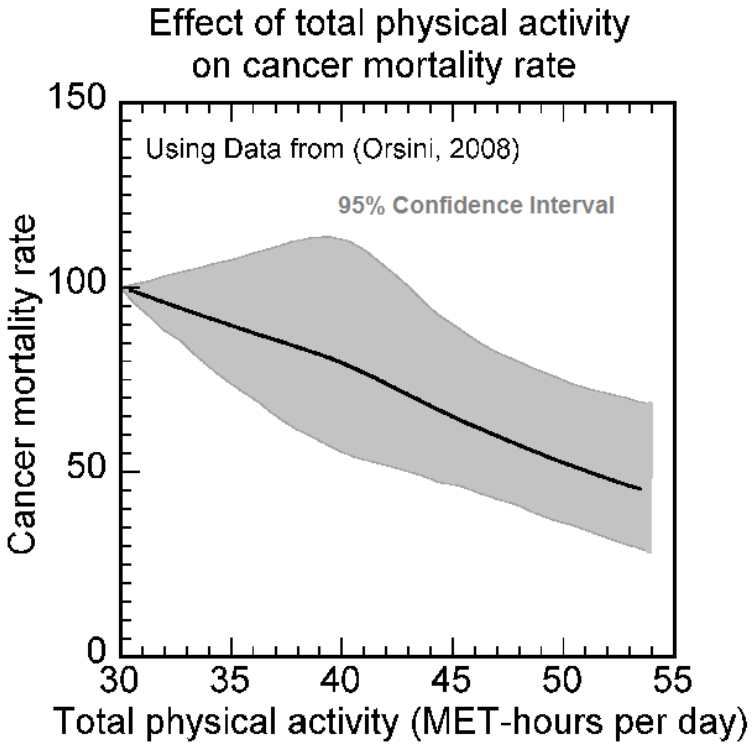
Obviously No.

For the maximum dose avoided by Fukushima evacuation, 70 mSv, Cancer mortality risk was reduced by ~2% (using the LNT model)

Considering the large number of fatalities caused by the evacuation, was there a better method of reducing cancer rates in this population?

Cancer risk is affected by many factors, not only by radiation.

A Better Approach to Fukushima-like situation

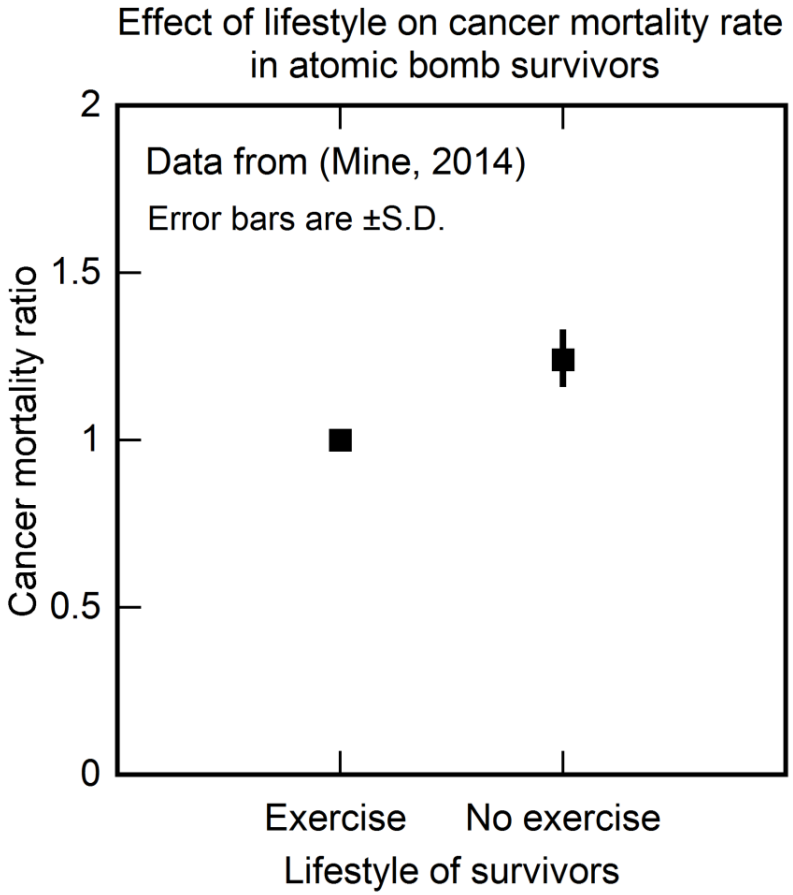


Provide increased exercise facilities, education

– increase population engaging in vigorous exercise would reduce cancer rate more than the LNT model projected increase.

No evacuation → no evacuation-related deaths, normal life.

Effect of Exercise on Cancer Mortality Rate in Atomic Bomb Survivors



(Mine, 2014): Mine M, Yokota K, Shibata Y. Relationship between life style and mortality among atomic bomb survivors. IEA World Congress of Epidemiology; Anchorage, Alaska, 2014.

Justification for the LNT Model

Justification for the LNT Model

Radiation → DNA damage → Mutations → Cancer

All are assumed to be linear relationships.

Hence, excess cancers increase linearly with radiation dose.

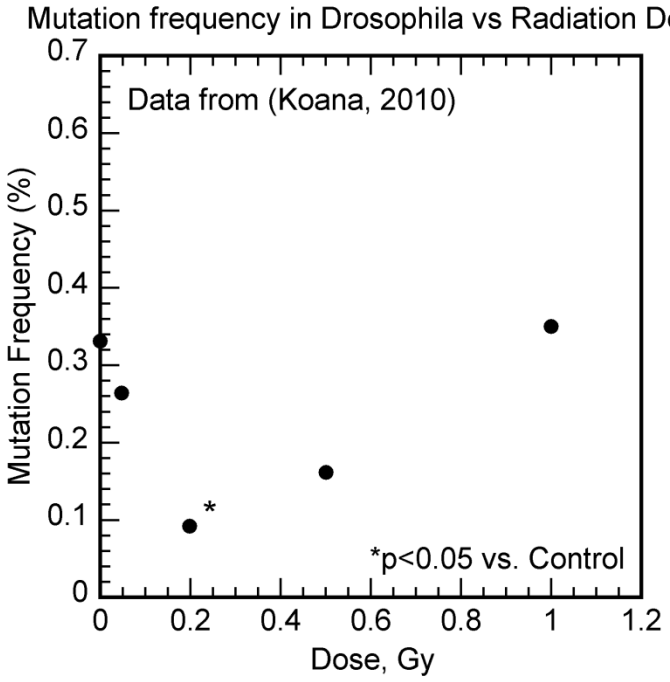
Even a single ray of radiation → DNA damage

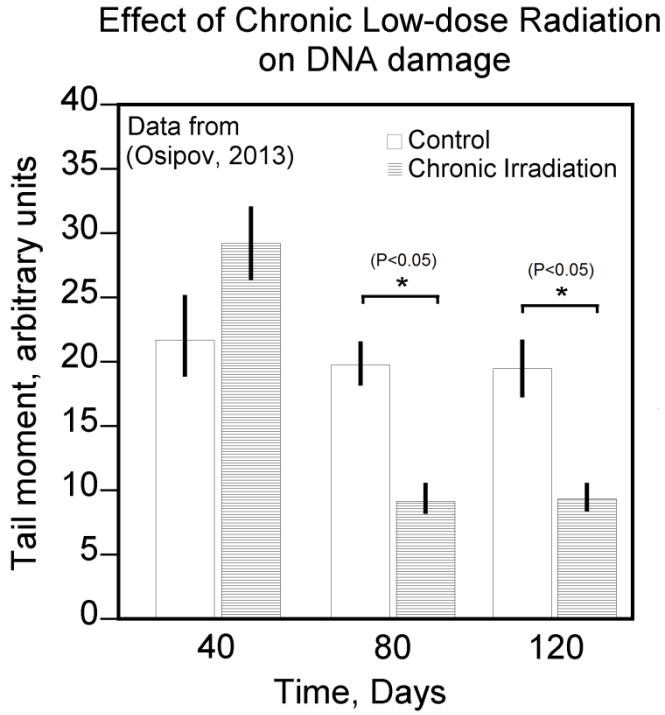
Hence, No Threshold.

Thus, we have the Linear No-Threshold (LNT) Model

Major Defects of the LNT Model

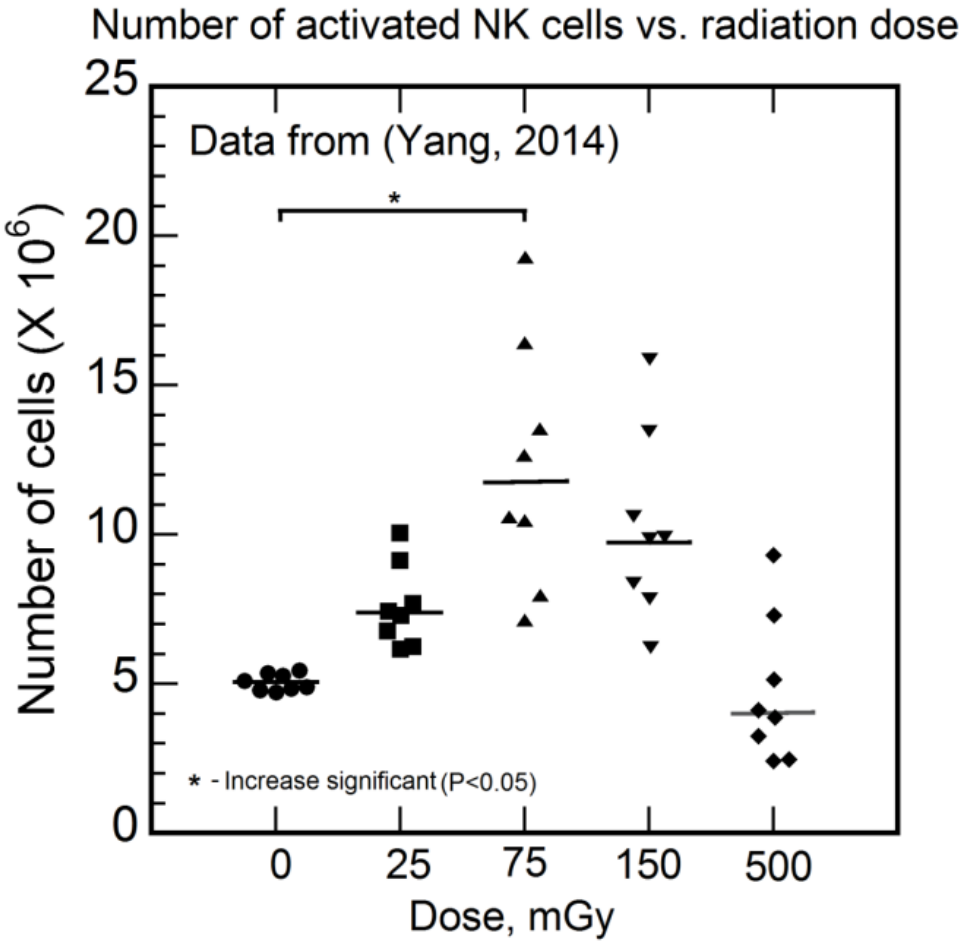
Effect of low-dose radiation on DNA damage and mutations





There is no linearity at low doses. Reduction of DNA damage at low doses due to activation of defenses known as adaptive protection (Feinendegen, 2013)

Effect of low-dose radiation on the immune system



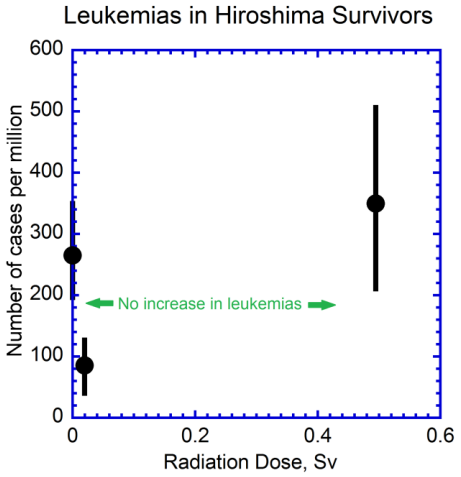
Low-dose radiation stimulates NK cells – part of immune system - which prevents cancers

Ignoring these important factors is naïve and simplistic, and would result in wrong conclusions.

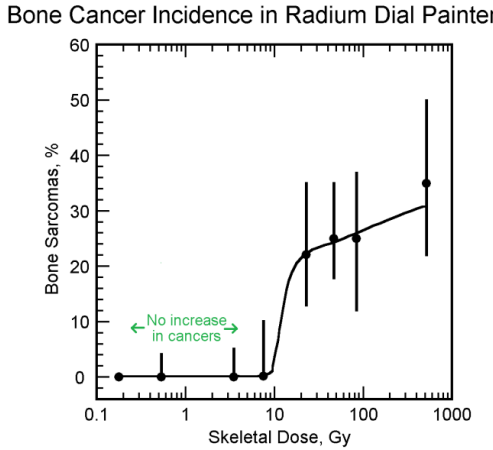
LNT Model is Naïve, Simplistic, and Wrong

Data does not back up the LNT Model

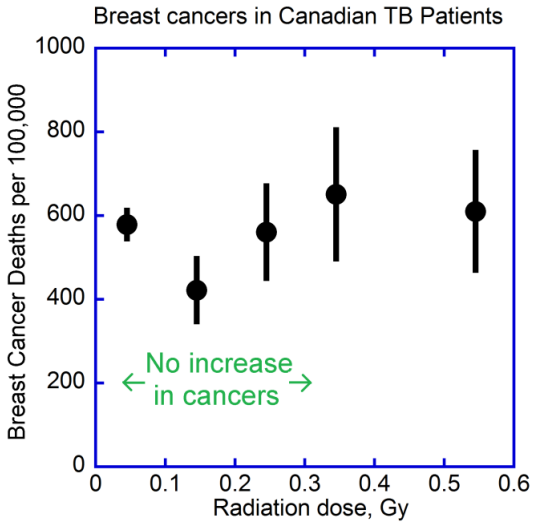
Reduction of cancers or no increase in cancers from low-dose radiation exposures



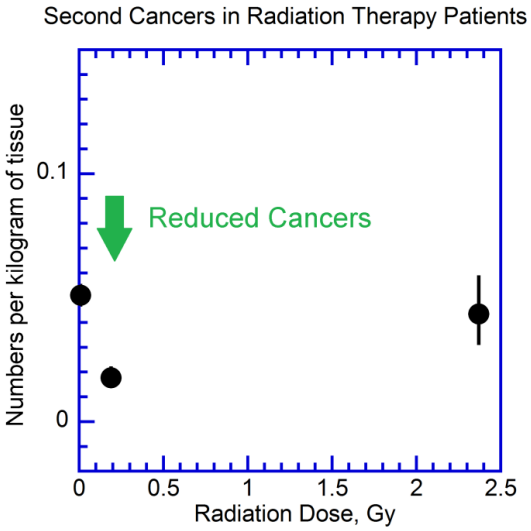
Cuttler, 2014, UNSCEAR, 1958



Rowland, 1983, Sanders, 2006



Miller et al, 1989



Tubiana, et al., 2011

Data most often quoted to support the LNT model are the

Atomic bomb survivor data

E.g. in BEIR VII Report

by National Academy of Sciences (USA)

Atomic bomb survivor data

The data in the latest update (Ozasa, 2012) do not support the LNT model.

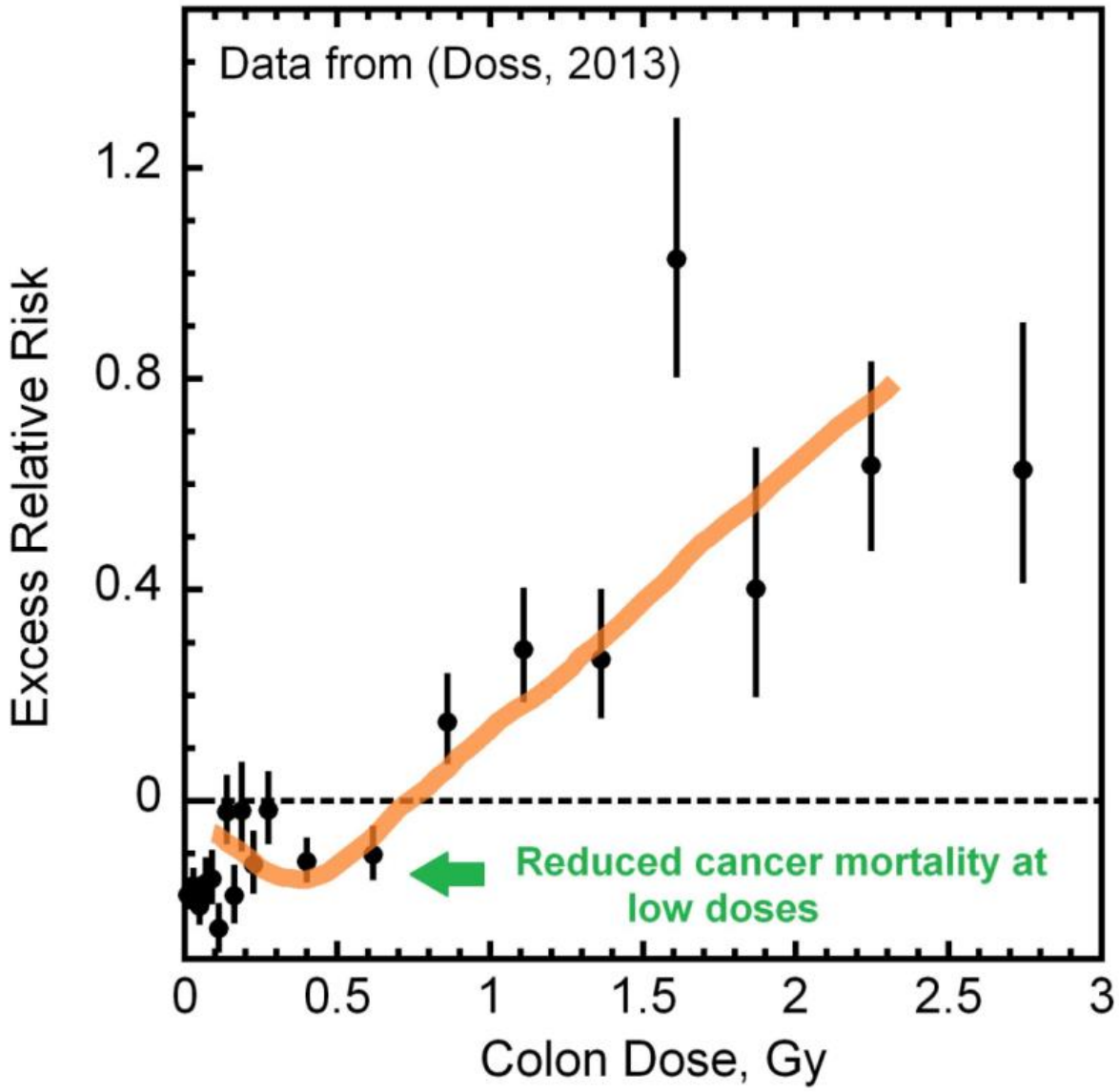
For details:

1. Evidence Supporting Radiation Hormesis in Atomic Bomb Survivor Cancer Mortality Data, Doss, 2012

2. Comments on "Studies of the mortality of atomic bomb survivors, Report 14, 1950-2003: an overview of cancer and noncancer diseases, Ozasa et al. 2012). **M. Doss**, B. L. Egleston and S. Litwin, 2012

3. Linear No-Threshold Model vs. Radiation Hormesis, Doss, 2013

Atomic Bomb Survivor Solid Cancer Mortality (Ozasa, 2012)
Corrected for -20% assumed bias in baseline cancer mortality rate



Recent debate in Medical Physics (2014)

Point/Counterpoint: Low-dose radiation is beneficial, not harmful

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Radiation Epidemiology Branch, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20892-9778
(Tel: 240-276-7375; E-mail: mark.little@nih.gov)

Colin G. Orton, Ph.D., Moderator

(Received 3 May 2014; accepted for publication 5 May 2014; published 12 June 2014)

[http://dx.doi.org/10.1118/1.4881095]

Opening Statement

- did not use atomic bomb survivor data to show cancer risk from low-dose radiation

- used some pediatric and in-utero data that had already been refuted in literature or could be easily refuted

Note: In earlier such debates, atomic bomb survivor data played a major role.

Many publications claim low-dose radiation causes cancers

However, they have been found to have:

- major flaws in data, analysis, and/or interpretation,
- nullifying or raising major doubts about their conclusions

E.g. see the criticisms at the links:

The 15-country study of radiation workers:

see (Zablotska, 2013)

Studies of cancers following childhood CT scans:

see (Boice, 2013), (Socol, 2015)

Taiwan Study Residents in Radio-contaminated Buildings:

see (Doss,2013)

Breast Cancers in Canadian Fluoroscopic TB Patients:

see (Muckerheide, 1999)

There is not even a single publication that shows a definitive increased cancer risk from low-dose radiation.

Another reason to reject the LNT Model: Its Questionable Origin

The first advisory body to adopt
the LNT Model
was the Genetics Panel of the
National Academy of Sciences (NAS)
Biological Effects of Atomic Radiation (BEAR) I
Committee in 1956.

(Calabrese, 2009)

1956 Summary Report of BEAR I Genetics Committee

Some of the statements in the summary report:

"The genetic harm is proportional to the total dose"

"there is no such figure other than zero" (for amount of radiation that is genetically harmless)

"our society should hold additional radiation exposure as low as it possibly can"

Genetic Effects of Atomic Radiation: Committee on Genetic Effects of Atomic Radiation. Science, 1956

Full Text of the BEAR I Genetics Panel Summary Report was published in the New York Times, June 13, 1956.

→high publicity to the report

→ Tremendous public concerns about low-dose radiation

Statements in letters between the BEAR I/II Genetics Committee members in 1957

"I, myself, have a **hard time keeping a straight face** when there is talk about **genetic deaths and the tremendous dangers of irradiation**. I know that a number of very prominent geneticists, and people whose opinions you value highly, agree with me."

See (Calabrese, 2014) (Seltzer, 2007)

Statements in letters between the BEAR I/II Genetics Committee members

"Let us be honest with ourselves—we are both **interested in genetics research**, and for the sake of it, we are **willing to stretch a point** when necessary", and

See (Calabrese, 2014) (Seltzer, 2007)

(Note: Stretch a point = Exaggerate)

Statements in letters between the BEAR I/II Genetics Committee members

"Now, the business of genetic effects of atomic energy has produced **a public scare**, and a consequent interest in and recognition of importance of genetics. This is to the good, since it will make some people read up on genetics who would not have done so otherwise, and it may lead to the powers-that-be **giving money for genetic research** which they would not give otherwise."

See (Calabrese, 2014) (Seltzer, 2007)

Columbia University
in the City of New York
NEW YORK 27, N. Y.
DEPARTMENT OF ZOÖLOGY

Flagstaff, Arizona
August 13, 1957

Dear Milislav:

Being close friends of almost 30 years standing, we should be able to understand each other, if not necessarily to agree with each other on all points.

Let us be honest with ourselves - we are both interested in genetics research, and for the sake of it are willing to stretch a point when necessary. But let us not stretch it to the breaking point! Overstatements are sometimes dangerous, since they result in

Now, the business of genetic effects of atomic energy has produced a public scare, and a consequent interest in and recognition of importance of genetics. This is to the good, since it will make some people read up on genetics who would not have done so otherwise, and it may lead to the powers-that-be giving money for genetic research which they would not give otherwise. But let us not forget

nobody but you from whom I can get news.

As ever,

Th. Dobzhansky

Southwestern Research Station
Portal, Arizona

Excerpts from: Dobzhansky letter to Demerec (1957b) August 13 Letter, Milislav Demerec papers. Reproduced with permission from American Philosophical Society Library.

BEAR I/II Committee Members:

- did not consider low levels of radiation to be dangerous
- were willing to exaggerate risk from low levels of radiation to improve funding for genetics research
- were pleased that there was a public scare about the genetics effects of radiation (after the publication of the Genetics Panel Report), as it may lead to increased funding for research

LNT Model has questionable origin, its adoption was apparently motivated by self-interest.

Similar motivation cannot be excluded for its continuing support by those who benefit from its persistence.

The various advisory bodies have repeatedly endorsed the LNT model over the past several decades.

As seen in previous slides, there is overwhelming evidence for the cancer preventive effect of low-dose radiation, and there is no definitive evidence for cancers caused by low-dose radiation.

How can advisory committees repeatedly come to the wrong conclusion?

By ignoring or dismissing evidence contradicting their conclusion

E.g. BEIR VII report dismissed the importance of immune system in preventing cancer. It also dismissed the enhanced immune system response from LDR by stating (on page 333): “Although evidence for stimulatory effects from low doses has been presented, little if any evidence is offered concerning the ultimate deleterious effects that may occur.”

This statement ignores all the evidence presented earlier for the reduction of cancers from low-dose radiation, most of it pre-dating the BEIR VII report.

A number of scientists
have challenged
the validity of the LNT model
over the years – but the advisory
bodies have dismissed or
ignored their arguments.

The immensity of the harm caused in Fukushima and elsewhere by the use of the LNT Model have led many professionals from different countries and a wide variety of backgrounds to join together, in an attempt to overcome the menace of the current radiation safety paradigm based on the LNT Model.

A new international group of scientists called
"Scientists for Accurate Radiation Information" or SARI
was formed in 2013, at about the same time
Society for Radiation Information (SRI) was formed in Japan.

SARI Website: http://radiationeffects.org/

Wade Allison and I are founding members of SARI

SARI Membership List as of Feb 2015

Members:

1. Adams, Rod, MS , Atomic Insights LLC
2. Allison , Wade, PhD, Emeritus Professor of Physics, University of Oxford
3. Anderson, Rip, PhD, Sandia National Laboratories (Retired)
4. Angwin, Meredith, BS, MS, Carnot Communications
5. Bernal, Frederico, PhD, University of Buenos Aires in Argentina
6. Borders, Rex, MS, DOE/NNSA
7. Brodsky, Allen, Sc.D., CHP, CIH, DABR, Georgetown University
8. Brooks, Tony, PhD, Washington State University (Retired)
9. Brozowski, George, BS, Radiation Technology, U.S. EPA, Region 6
10. Bus, James, PhD, Exponent – Engineering and Scientific Consulting
11. Cai, Lu, MD, PhD, University of Louisville
12. Cohen, Mervyn, MBChB, Indiana University
13. Conca, Jim, PhD, Senior Scientist at UFA Ventures, Inc.
14. Leslie E. Corrice, MA, Self-employed / Semi-retired
15. Cox, Morgan, MS, Consultant
16. Cuttler, Jerry M, DSc in Nuclear Sciences, Cuttler & Associates
17. Davey, Chris, B.S., King Abdullah University of Science and Technology, (KAUST)
18. Denman, Matt, PhD, Sandia National Laboratories
19. Dobrzynski, Ludwik, D.Sc., National Center for Nuclear Research, Poland
20. Doss, Mohan, PhD, Associate Professor, Fox Chase Cancer Center
21. Dube, Scott, M.S., Morton Plant Hospital
22. Easty, Mack, MD, U.S.Army (retired)
23. Esposito, Vincent J., PhD, Adjunct Prof. Uni of Pittsburgh (Retired)
24. Farooque, Abdullah, MS, Institute of Nuclear Medicine and Allied Sciences, Delhi, India
25. Feinendegen, Ludwig E., MD, Heinrich-Heine University University Dusseldorf, Germany
26. Fellman, Alan, Ph.D., Dade Moeller & Associates, Inc.
27. Fisher, Darrell, Ph.D., Dade Moeller Health Group
28. Fornalski, Krzysztof, Ph.D., Eng, Polish Nuclear Society (PTN)
29. Franz J, Freibert, PhD, Los Alamos National Laboratory
30. Golden, Robert, PhD, ToxLogic
31. Gomez, Leo, Ph.D., Sandia National Laboratories (Retired)
32. Hansen, Richard (Rick), BS, National Security Technologies, LLC (NSTec)
33. Haque, Munima, PhD, Southeast University, Dhaka, Bangaladesh
34. Hargraves, Robert, PhD, Dartmouth College
35. Hart, John, DC, MHSc, Chiropractor
36. Hattori, Sadao, Ph.D., Central Research Institute of Electric Power Industry (CRIEPI)
37. Hayes, Rob, PhD, Nuclear Waste Partnership LLC/WIPP
38. Higson, Don, Ph.D., Australian Nuclear Science and Technology Organisation (Retired)
39. Hiserodt, Ed, BS, Controls & Power, Inc
40. Hylko, Jim, MS (MPH), Enercon Federal Services, Inc.
41. Janiak, Marek K., Ph.D., Military Institute of Hygiene & Epidemiology, Warsaw, Poland
42. Kaspar, Matthew, MS, Sandia National Laboratories
43. Kesavan, P.C., Ph.D., M.S. Swaminathan Research Foundation, India
44. Kollar, Lenka, MS, Nuclear Undone LLC
45. Laster, Brenda, Ph.D., Ben Gurion University
46. Little, Craig A., Ph.D., Two Lines, Inc.
47. Mahn, Jeffrey, MS, Sandia National Laboratories (Retired)
48. Malenfant, Richard, MS, MBA, Los Alamos National Laboratory (Retired)
49. Marcus, Carol Silber, Ph.D., M.D., ABNM, UCLA
50. McCollough, Cynthia H., PhD, Mayo Clinic
51. Miller, Mark, MS, Sandia National Laboratories
52. Mortazavi, SMJ, PhD, Professor, Shiraz University of Medical Sciences
53. Nowosielska, Eva, PhD, Military Institute of Hygiene and Epidemiology, Poland
54. Orient, Jane, MD, Doctors for Disaster Preparedness
55. Osborn, Doug, PhD, Sandia National Laboratories
56. Payne, Steven S., PhD, DOE/NNSA
57. Pennington, Charles, MS/MBA, Private Consultant
58. Philbin, Jeff, PhD, Nuclear Safety Associates
59. Rangacharyulu, Chary, PhD, University of Saskatchewan, Canada
60. Reeves, Glen I., MD, Applied Research Associates, Inc.
61. Rithidech, Kanokporn , PhD, Professor of Research Pathology , Stony Brook University
62. Rossin, A. David, PhD, Independent consultant on nuclear power safety
63. Ruedig, Elizabeth, PhD, Postdoctoral Fellow, Colorado State University
64. Sackett, John, PhD, Argonne National Laboratory (retired)
65. Sacks, Bill, PhD, MD, FDA's Center for Devices and Radiological Health (Retired)
66. Sacks, Miriam, RT, Kaiser Permanente, Washington, DC (Retired)
67. Sanders, Charles L, PhD, (Retired)
68. Scott, B.R., PhD, Lovelace Respiratory Research Institute (LRRI)
69. Siegel, Jeffry, PhD, Nuclear Physics Enterprises
70. Socol, Yehoshua, PhD, Falcon Analytics, Israel
71. Stabin, Michael, PhD, Vanderbilt University
72. Strupczewski , Andrzej, DSc, National Centre for Nuclear Research, Poland
73. Sutou, Shizuyo, PhD, Functional Genomics, School of Pharmacy, Shujitsu University
74. Troyer, Gary L., B.S., M.S., Self-employed / Semi-retired
75. Uhlik, Chris, PhD, Google & Martingale
76. Ulsh , Brant, PhD, CHP, MH Chew and Associates
77. Vaiserman, Alexander, PhD, Institute of Gerontology, Kiev
78. Waltar, Alan, PhD, Texas A&M University (Retired)
79. Weiner, Ruth F., PhD, Sandia National Laboratories (Retired)
80. Welsh, James, MS, MD, University of Wisconsin

Associate Members:

81. Cravens, Gwyneth, MA, Self-employed writer
82. Fujita, Hiroyuki, 4-Yr Univ., Writer, translator, corporate trainer
83. Jennetta, Andrea, B.A., Fuel Cycle Week / Int'l. Nuclear Associates, Inc.
84. Lewis, Patricia, n/a, Free Enterprise Radon Health Mine
85. Meyerson, Gregory, PhD, North Carolina A and T University
86. Morales, Bert, BS, MBA, UniTech Services Group
87. Rowland, Tawnya, BS, Bus. Admin, Lovelace Respiratory Research Institute
88. Terrell, Rebecca, MBA, The New American magazine (environmental issues contributor)
89. Trujillo, Jennifer, BS, Eye Associates of New Mexico

Examples of SARI efforts

An Open Letter to Advisory Bodies Regarding Low Dose Radiation Cancer Risk (Feb 2014)

- asking them to recommend to governments that they discontinue the use of the LNT model for radiation safety purposes, supplanting it with a threshold model.

Examples of SARI efforts

An Open Letter to Advisory Bodies regarding the disastrous consequences from the use of the LNT model at Fukushima Daiichi (Nov 2014)

- asking them to make a firm, unconditional statement to the Fukushima residents that returning to their homes would not increase their risk of cancer

One advisory body responded referring to their report stating that risk to returning Fukushima residents would be acceptable.

Are advisory bodies changing direction in view of evidence contradicting the LNT Model?

At the recent scoping meeting for BEIR VIII Report

Speakers referred to discredited studies

Cancers following pediatric CT scans,

15-Country Study of Radiation Workers

- showing increased low-dose radiation cancer risk

But ignored

Deviation from linearity of atomic bomb survivor data,

Nuclear Shipyard Worker Study,

Study of second cancers in radiation therapy patients

– showing decreased cancer risk from low-dose radiation

Self-correcting nature of science is not in action.

How can we use all the information above to deal with low-dose radiation in Fukushima?

Resettlement of evacuated population

UNSCEAR 2013 Report:

Maximum annual radiation dose to evacuees
(for return on March 11, 2014) 4.9 mSv
(see Table C19 of the report).

Based on evidence and reasons presented, such increase in annual radiation dose would not increase cancer risk, but would decrease cancer risk.

Fukushima area residents should be assured they would face no increased cancer risk if they returned to their homes now, and they should be asked to return.

Resettlement of evacuated population

You may ask: Aren't the residents exceeding the public radiation dose limit of 1 mSv per year?

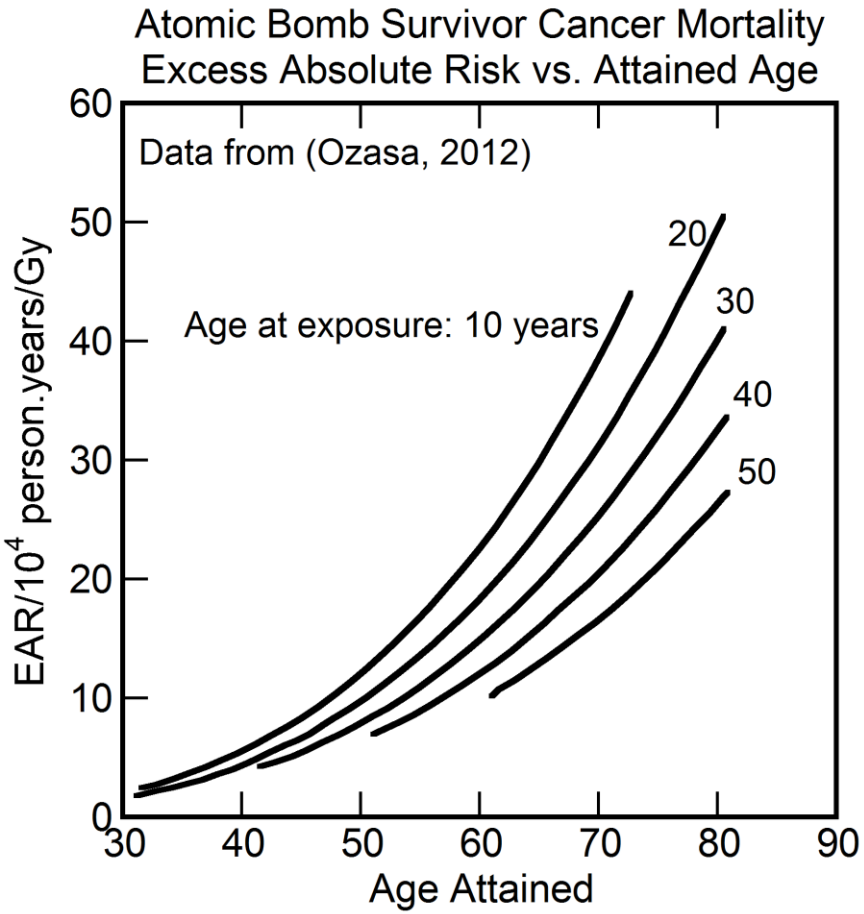
Isn't the 1 mSv/y dose limit a superstitious practice, because of all the evidence that points to reduction of cancers for low doses?

Therefore, the current public annual radiation dose limit of 1 mSv should be scrapped.

While awaiting setting of the new radiation dose limits that recognize the cancer preventive effect of low-dose radiation, public radiation dose limit should be raised immediately to be similar to that of radiation workers, e.g., 20 mSv per year, to facilitate immediate return of the Fukushima area residents.

Are Low-dose Radiation exposures of concern for children?

Data shown to raise the concerns



However, these data are for high-dose radiation exposures.

Only by LNT model extrapolation, these graphs are extended to low-doses.

But since there is no evidence for the LNT model, extension of the graph to low doses is not valid.

Are children at risk from low-dose radiation?

Arguments used to raise concerns:

Children

- have higher proportion of dividing cells,
- more susceptible to mutations due to radiation.

This argument ignores adaptive protection.

Low-dose radiation → adaptive protection

- reduces overall mutations
- enhances the immune system
  - would reduce cancers

NO CONCERNS REGARDING LOW-DOSE RADIATION EXPOSURES TO CHILDREN

Dealing with radioactively contaminated water from damaged nuclear power plants

Exception should be made to the policy regarding discharge of waste into the ocean:

- situation with the Fukushima nuclear reactors is extraordinary as it arose following the rare double major natural disasters
- low impact on the ocean biota or to humans from such occasional release of the radioactively contaminated water because of the enormous diluting power of the ocean and the resulting reduction in the radiation doses to very low levels.

Dealing with misinformation on the health effects of low-dose radiation

Public belief that low-dose radiation causes cancers is based on reports from advisory bodies and reports in popular media that receive tremendous publicity

A public education campaign is needed to overcome the misinformation and would require considerable resources (e.g. $1B/y)

A government or non-profit agency should

- correct the misinformation regarding low-dose radiation in popular media

- engage fear-mongers in public debates challenging their points of view with detailed evidence.

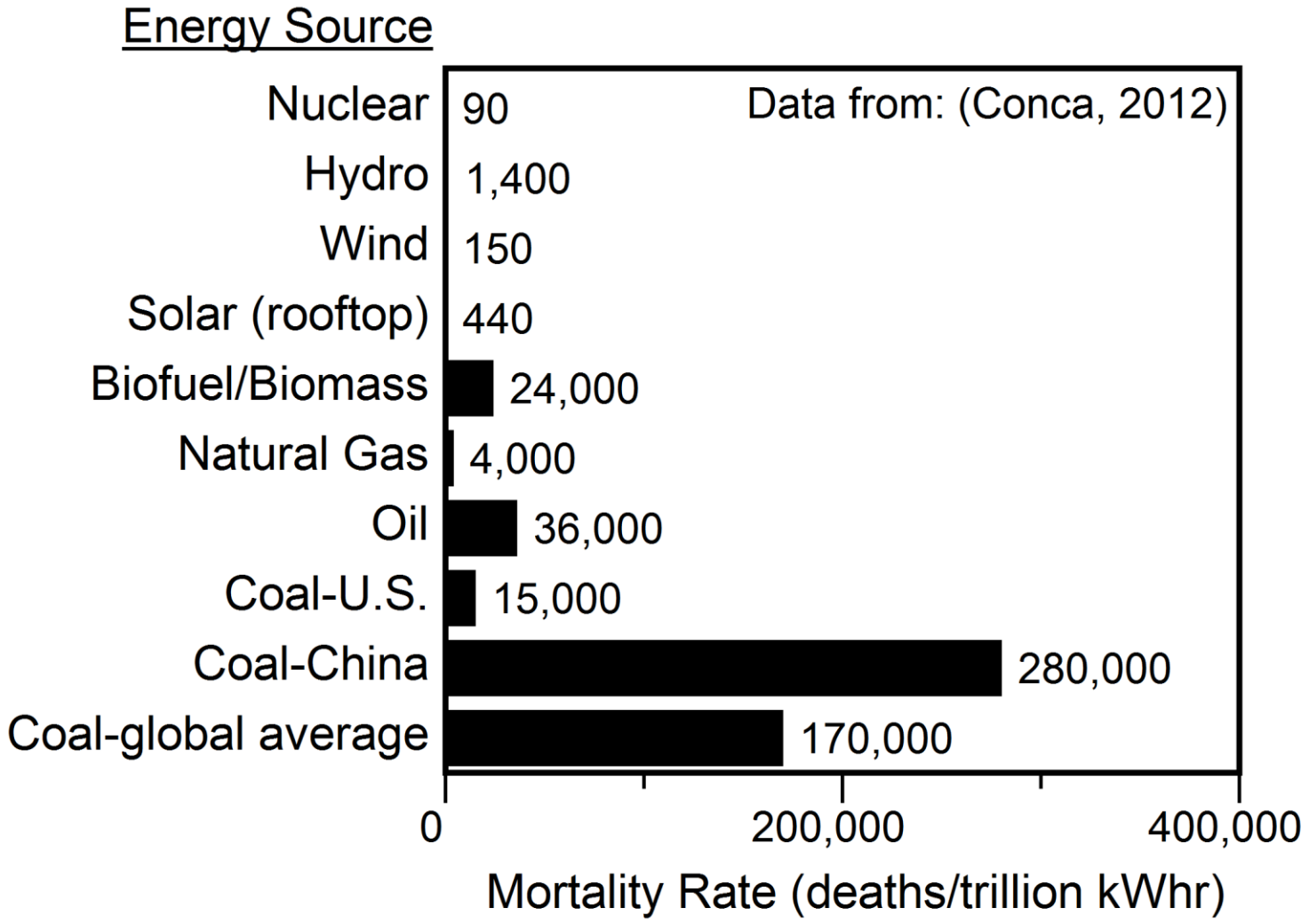
Resumption of Nuclear Power Plant (NPP) operations

In Fukushima, no one died from radiation exposures and no one is expected to die from radiation effects, in spite of the NPP accidents being major ones.

In comparison: 8 Deaths and 79 injuries occurred from a recent accident involving local natural gas pipelines in New York.

If this neighborhood had utilized energy from NPPs rather than from natural gas, these deaths and injuries could have been prevented.

Comparison of mortality rate from energy sources



Resumption of Nuclear Power Plant operations

- Thus, there was indeed no justification for the Japanese government's decision to shut down all the NPP operations based on the single set of accidents in 2011.
- NPP operations should be resumed as soon as possible after recommended modifications are completed to avoid the type of accidents that occurred in Fukushima.
- A sustained, intense public education campaign should be launched on the relative safety of nuclear power in comparison to other sources,
- Those objecting to the resumption of NPP operations should be engaged in public debates on the safety of nuclear power to allay their concerns and to demonstrate to the public their unreasonableness and the likely dangers from acquiescing to their persistent, vocal, but illogical objections.

Considering the large infrastructure that has developed in support of the LNT Model, dismantling it would require tremendous resources. Individual efforts by scientists or groups like SARI or SRI would not be sufficient. Government action is needed to engineer the change.

Inquiry Commission

Considering the magnitude of the disastrous consequences in Fukushima,

A Parliamentary Inquiry Commission should be set up to

- investigate basic reasons for the consequences
- make recommendations to prevent similar occurrences in the future

Such an inquiry would result in identifying the LNT Model as the reason for the calamity and would justify a change in the radiation safety paradigm

New advisory bodies needed

Present advisory bodies:

- failed to broaden scope
  (to consider overall health,
  not only related to radiation)
- failed to respond to increasing evidence
  against the LNT model

New advisory bodies need to be formed:

- corrected mission of focus on overall health
- change structure so that scientific method
  is followed (i.e. evidence is not ignored).

Changes needed in regulatory agencies

Regulatory agencies:

- consider overall health
  (in addition to radiological health)
- take steps to prevent fear of
  low-dose radiation

How to allay public fear of low-dose radiation

Discuss with the public:

- The abundance of accumulated evidence for the cancer preventive effect of low-dose radiation
- Origin of the LNT model and the role of self-interest in its adoption
- Deficiencies in current advisory bodies
- Adverse consequences from following the advisory body recommendations
- Financial interests in the persistence of the LNT Model

Japan should lead the world

- Japan has suffered the most from the current use of the LNT Model
- Therefore, Japan would indeed be justified in leading the world in transforming the radiation safety paradigm

Overcoming Superstitions

Major changes are challenging, but must be done in a planned, organized, but swift manner.

Overcoming Superstitions

Several of the SAMURAI qualities are needed:

1. Rectitude or Justice: decide upon a course of conduct in accordance with reason
2. Courage – act in spite of large opposition
3. Politeness – No need to be rude to opponents
4. Honesty and sincerity – “must grudge money, for riches hinder wisdom”
5. Loyalty – to Science

Recommendations

- Set up a government (or non-government) agency with funding of $1 billion per year to advertise and spread correct information to the public on the known health effects of low-dose radiation, and challenge and debate those spreading misinformation
- Program to inform and educate the thought-leaders about the health effects of low-dose radiation
- Set up new advisory bodies to provide recommendations on how to prevent the harm from high dose exposures while enabling the beneficial effects of low-dose radiation
- Change the radiation safety regulations by removing all the regulations for low-dose radiation resulting from the LNT model and ALARA concept. Maintain the regulations relating to high dose radiation exposures, and develop radiation safety practices to reduce the possibility of high dose exposures
- Professional education program to train the radiation safety professionals on the new radiation safety paradigm
- Set up a chain of research institutions to systematically evaluate low-dose radiation health effects with prospective studies, with gradually increasing doses to find the optimum dose with the most beneficial effect.

I wish you the best in your efforts to enable the evacuated Fukushima residents' return to their homes to resume normal life, and in overcoming the LNT Model superstition.

If you have any questions or concerns as you move forward, please feel free to contact me.

Thank you for your attention.

Questions?