

**Atomic Radiation:
More Harmful to
Girls and Women**

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Slides posted:
Original Art by Loren Olson



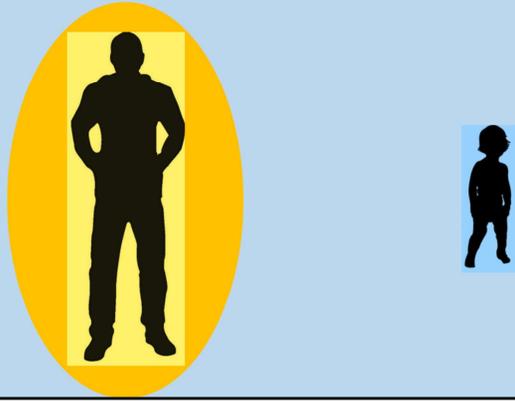
Thank you for this opportunity to speak, and thanks to all of you for listening.

My name is Mary Olson. I am here because Atomic Radiation is more harmful, to girls and women. Three Independent analysts have found this pattern; I am one of them. I have been attending nuclear summits and talking about Gender. I am really glad to be here with Gender focused people; very different!

Originally the abstract for today promised a discussion of the US EPA Protective Action Guides (PAGs). EPA is right now moving to finalize these and my Shop at home is is actively engaged. They have asked me to save that for the next paper.

These slides with references will be posted on RESEACH GATE under this title.

Radiation regulation has been based on
“Reference Man”



Historically, global radiation policy and regulation assumes that anyone being exposed to radiation is an adult male: a “Reference Man” has been used.

Official Definition of “Reference Man”

“Reference man is defined as being between 20-30 years of age, weighing 70 kg, is 170 cm in height, and lives in a climate with an average temperature of from 10° to 20°C. He is a Caucasian and is a Western European or North American in habitat and custom.”

Source: International Commission on Radiological Protection. *Report of the Task Group on Reference Man*. [ICRP Publication] No. 23. Oxford: Pergamon Press, 1975. Adopted October 1974. Page 4.

Note:
70 kilograms ≈ 154 pounds
170 centimeters ≈ 5 feet 7 inches

Reference man is defined:

US: 28 years old

70 Kg

170 cm tall

Living in Europe or US.

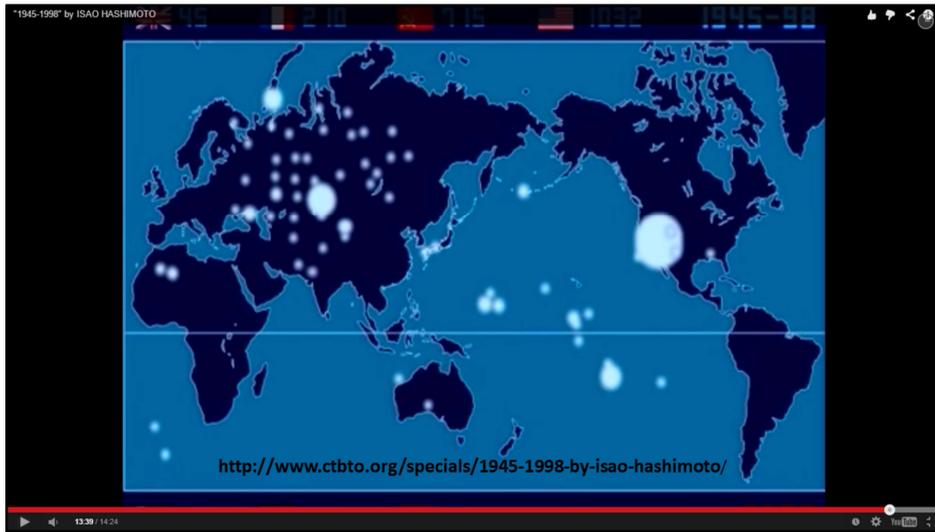
Climate and lifestyle are specified.



This made some sense 70—100 years ago at the beginning of human-directed activities resulting in intentional exposure to radiation.

It was World War II and the primary populations exposed were military and para-military males, sent in behind fences and barbed wire.

Regulation was for these restricted radiation zones.



Then the Cold War came and more than 2000 nuclear weapons were tested.

This is a map of the “ground zero” and relative number of tests, not the “fall-out.”

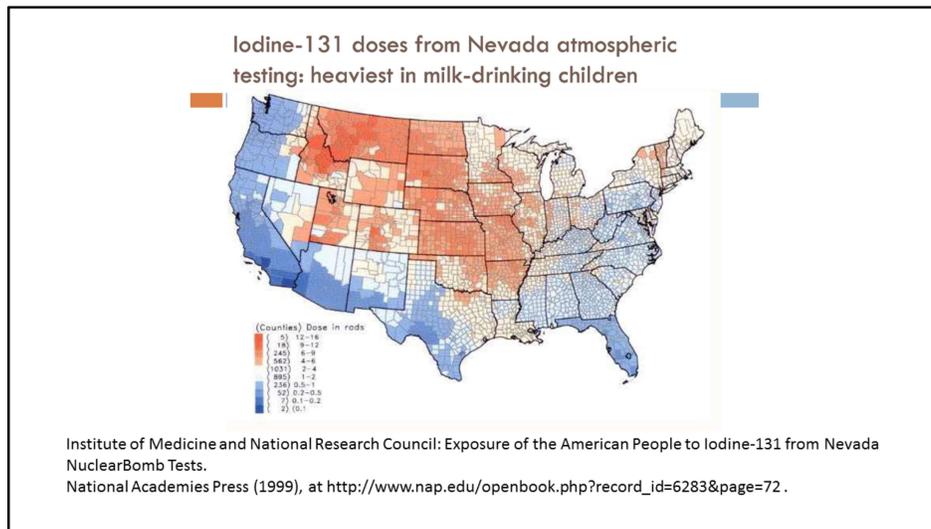
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Art Credit:

This image, used with permission from Mr. Hashimoto is a screen capture from a short film by Isao Hashimoto, entitled “1945-1998.” posted here:

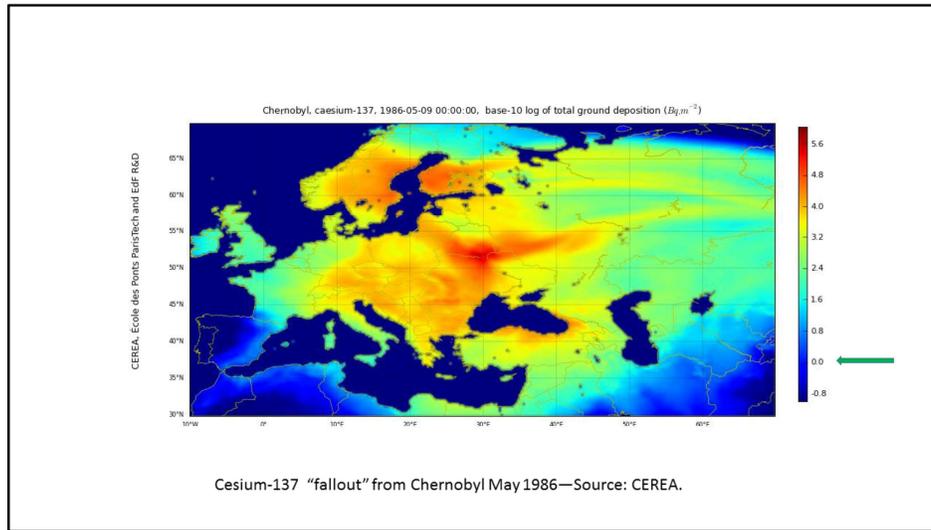
<http://www.ctbto.org/specials/1945-1998-by-isao-hashimoto/>

The DVD which shows the progression of nuclear explosions between 1945 and 1998, more than 2000 in all, is also available from the artist.



This map is of radiation exposure across the USA from radioactive fallout from nuclear weapons tests in Nevada.

Radioactive iodine in rain fell on grass consumed by cows. The radioactivity is concentrated in the milk that was consumed by families.



And in 1986 over night, an electric power-generating station did this:

Deposition of Cesium-137 from Chernobyl. Two thirds of the radioactivity landed outside the immediate region of the nuclear power station. The long-term health impacts will track with this distribution.

Perhaps this is an occasion for celebration:

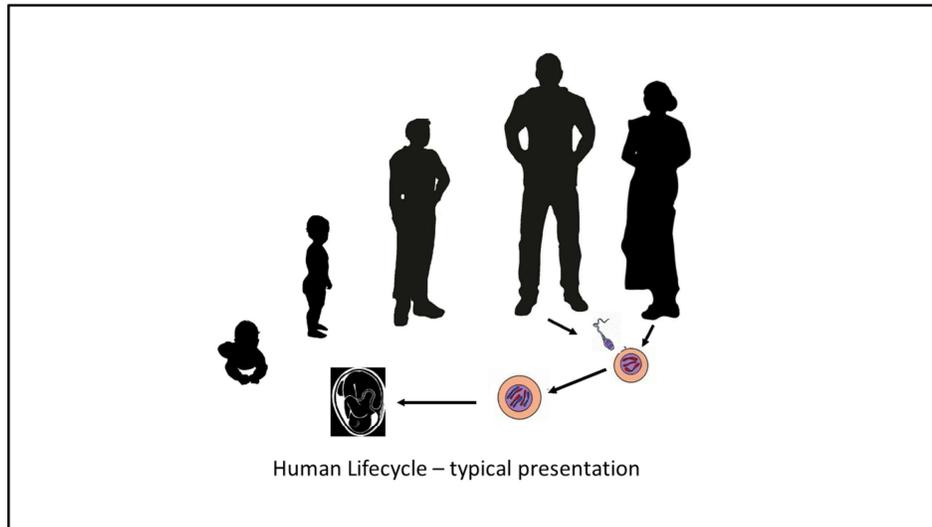
This year marks 30 years since April 26, 1986 and half of that cesium deposition is now gone...to stable Barium. Only nine more half-lives or 270 to go before this material is hard to detect.



Both maps include areas of human population where radiation levels are more than 100 times normal background levels.

Radiation from human activities is no longer behind the fences.

All parts of the Human lifecycle is exposed. It is no longer credible to have exposure limits based on a Reference Man.

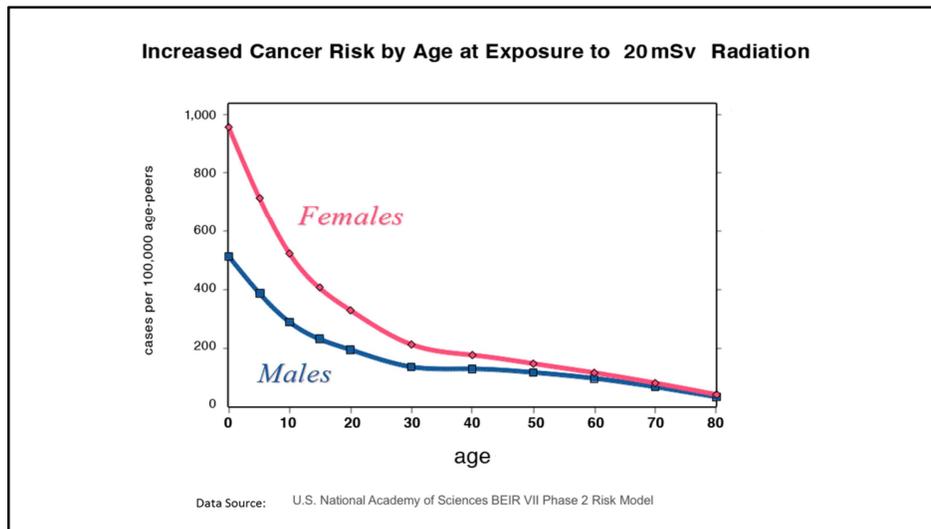


A US regulator recently asserted that little girls are a “sub-population.” Little girls are not a sub-population. We are an inextricable link in the human lifecycle.

The balance of this presentation is based on my own findings from the only large radiation-exposed and case-controlled data-set that contains all ages and both genders: the survivors of the nuclear destruction in 1945, by my government, the United States, of two Japanese cities, Hiroshima and Nagasaki.

150,000 people perished in 1945 and many more over time. Incredibly, five years after the bombing there were 125,000 survivors that the US initiated data-collection on.

This data is used widely, including by me, here today. Speaking only as one woman, I regret this history. I wish it had never happened. I am sorry.



Is gender a factor in radiation harm?

I am an educator, formerly a research scientist. After the Fukushima Daiichi nuclear disaster in 2011, women began asking me this question. None of my training mentioned gender in radiation impacts. In the case of cancer incidence and mortality over the lifetime from an acute exposure to external radiation, the answer is yes.

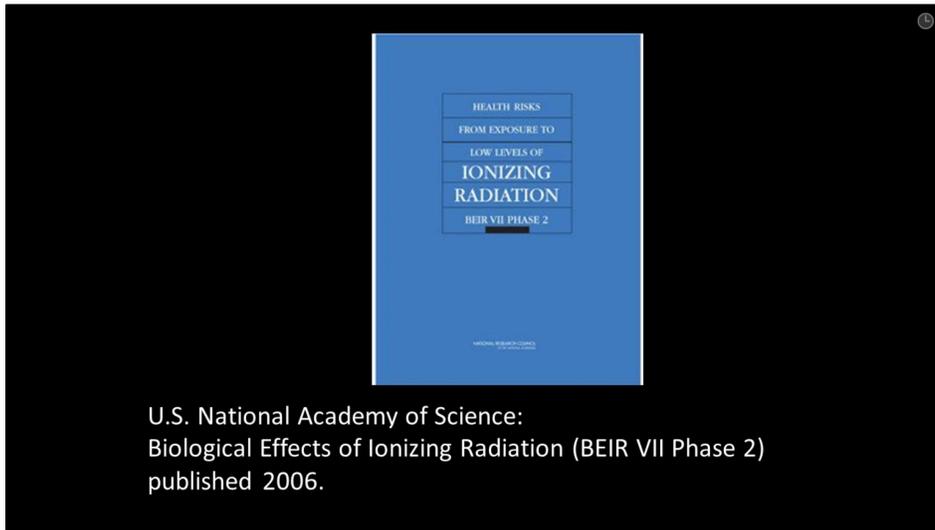
The data comes from a 2006 publication of 60 years of A-Bomb survivor data by the US National Academy of Science in their 7th report called “The Biological Effects of Radiation” or BEIR VII. The Survivors were grouped by the age they were at the time of the bombing; the report gives gender-specific tables of numbers, but no graphic presentation and Gender is not a feature of the discussion.

All I did was to create gender-specific age-of-exposure cancer-response curves on a fixed radiation exposure level of 20 mSv.

Dr Arjun Makhijani presented the same analysis in 2006 but I was not aware of his work, so my work is an independent confirmation of this pattern:

The pink line (girls and women) and the blue line (boys and men) are distinct across all the age-cohorts, but the difference is greatest on the left, in the birth—5 years cohort: the youngest boys and girls.

The difference is about double.



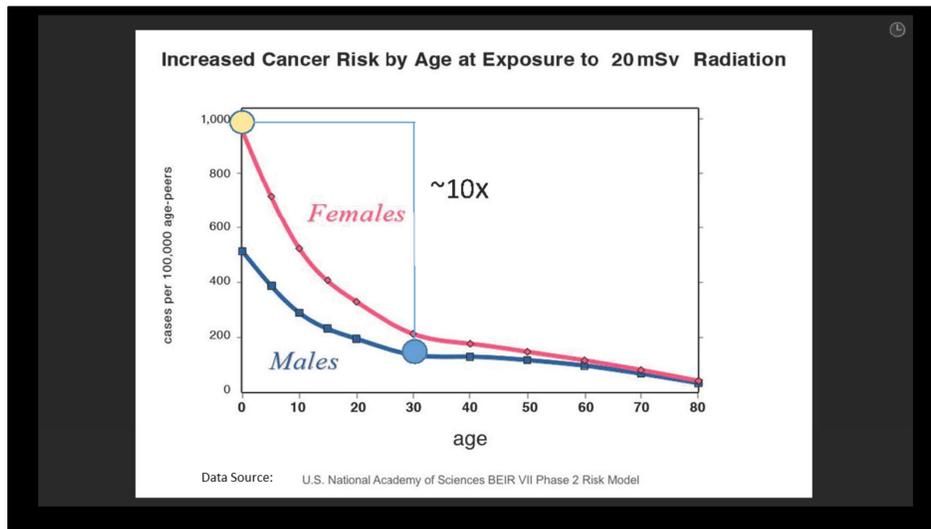
U.S. National Academy of Science:
Biological Effects of Ionizing Radiation (BEIR VII Phase 2)
published 2006.

This 2006 report, the Biological Effects of Ionizing Radiation, #7, also called BEIR VII is the source of the data I am discussing.

Citation:

The Biological Effects of Ionizing Radiation, VII; Phase 2 is available at no charge for a PDF file here: <http://www.nap.edu/openbook.php?isbn=030909156X>

Important note: BEIR VII assumes that the victim's radiation exposure was an acute external exposure (the moment of the bomb explosion); internalized radioactivity is not considered.



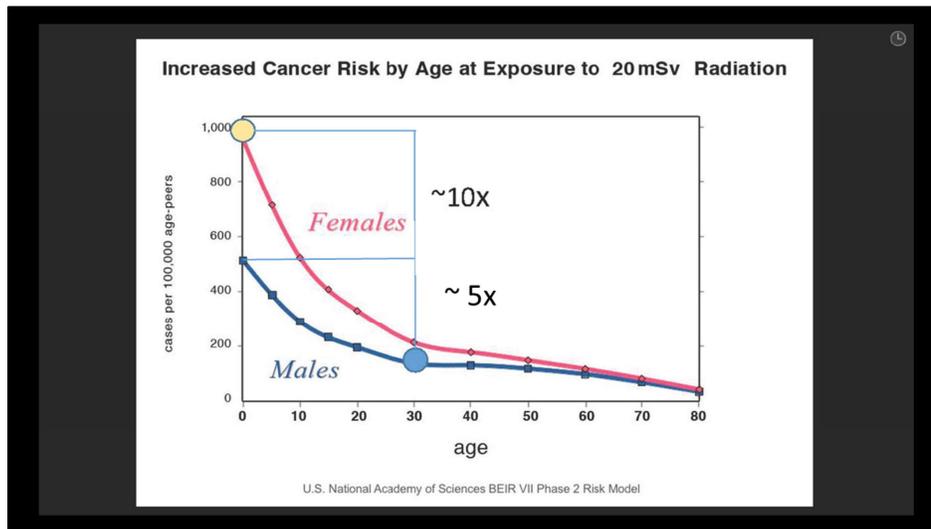
It is important to note that the graph does not show age of cancer incidence or death, and indeed, the expression of illness is across the lifetime.

A doubling in biological research is a flag.

Comparing the same youngest girls to the age-cohort corresponding to Reference Man (25-30) we can see there is ten times more harm to young females than expected by the regulators.

Ten times more is a RED flag.

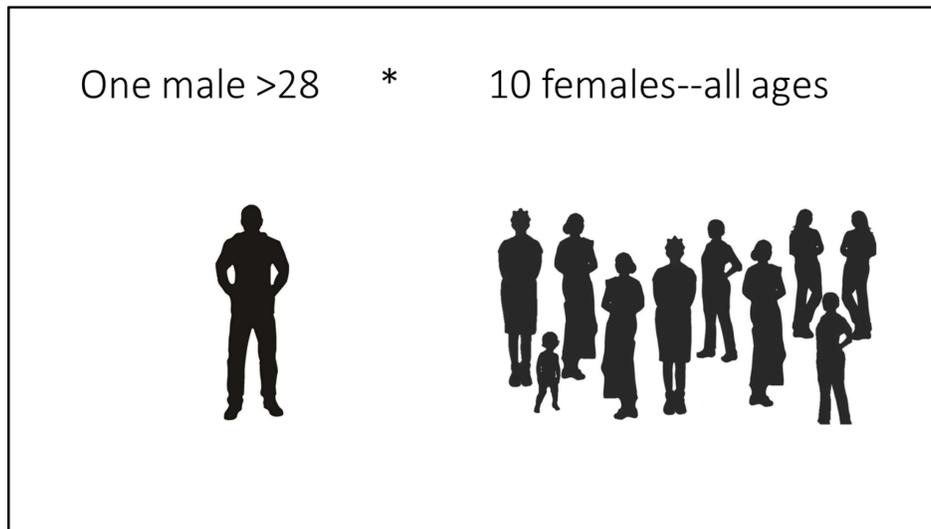
Since half of the human population is, or was at one time, a little girl this, this picture suggests that current regulation and policies supported by that regulation are off the mark. BY A LOT.



Now tag age of exposure as a factor:

The youngest cohort of males suffered about 5 times more cancer across their lifetimes than did the “Standard Man.” Again, these additional cancers are not all in childhood.

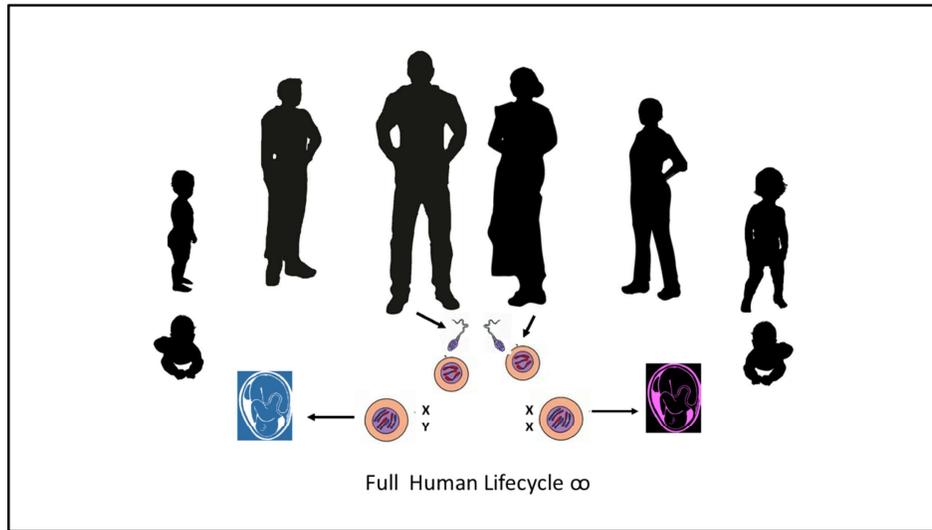
Failing to factor these additional outcomes in the male population suggests that overall evaluation of the harm of ionizing radiation is too low.



In addition to Dr Makhijani and myself, another analyst, Ian Goddard found this same patter in the A-Bomb Survivor data in 2011.

Visual information can be seen in more than one dimension. I constructed this slide One Standard Man vs 10 girls and women, and then another basic insight hit me.

Cancer is a “somatic” impact; individuals are exposed and researchers count the outcomes...but when there is such a BIG difference between male individual outcomes and female individual outcomes, we need another new picture.

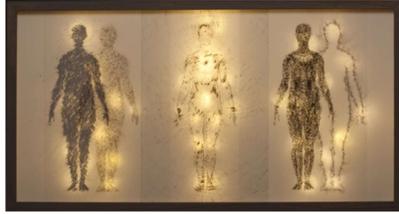


The lifecycle of our species cannot be accurately described by a single loop, such as the previous slide.

We need two loops: the male soma and the female soma. This is now a figure 8.

My sister says it is an infinity symbol ∞.

Radioactivity impacts all life on Earth

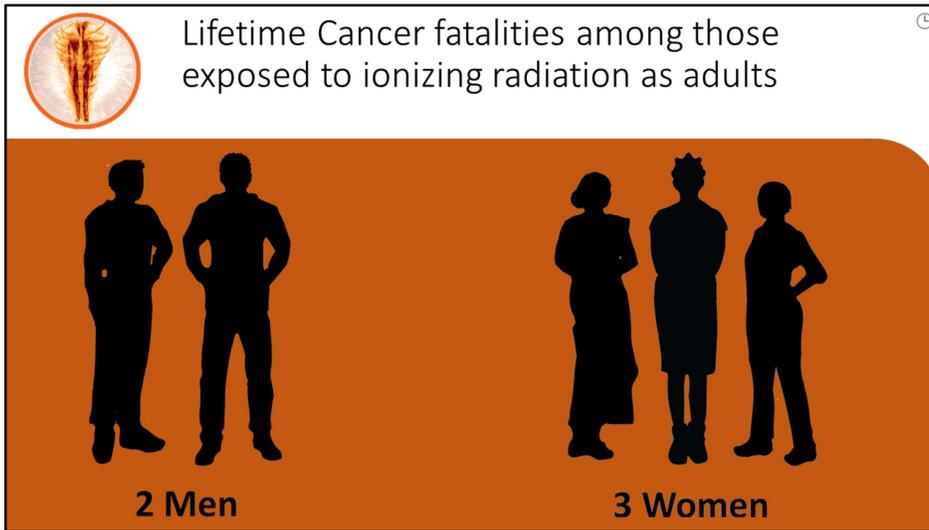


And I use her paintings to notate that I have only spoken about our species, but the impact is on all of life.



Many of the radionuclides will persist for millennia.

Earth's Biosphere is being changed in ways we cannot foretell.



Gender was also a factor for those who were adults at the time of the bombings.

Over their lifetime women exposed as adults suffered 50% more cancer death than did men in the same age group.

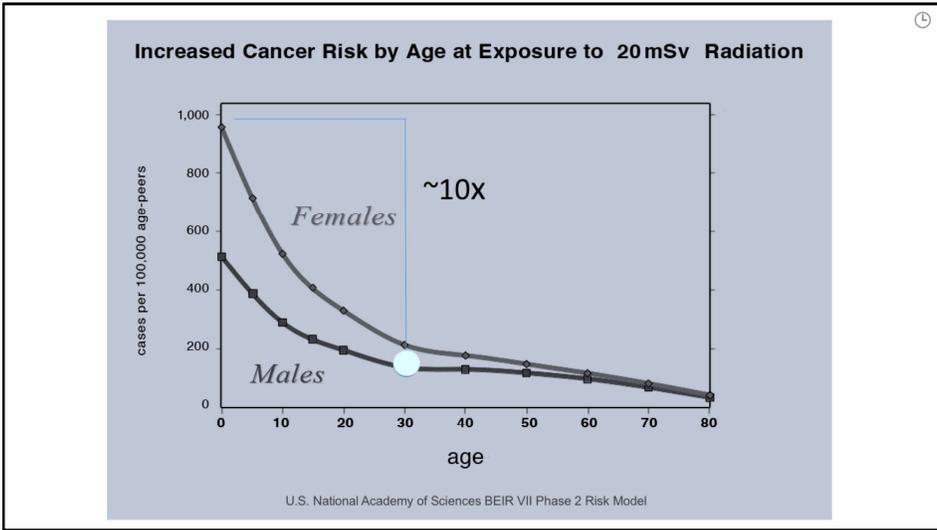
For every 2 men in these cohorts who died of cancer, three women died of cancer.

Source:

(see above) Olson, Makhijani, numbers in tables of BEIR VII.

Art Credit:

Saro Lynch-Thomason, Fullsteam Labs



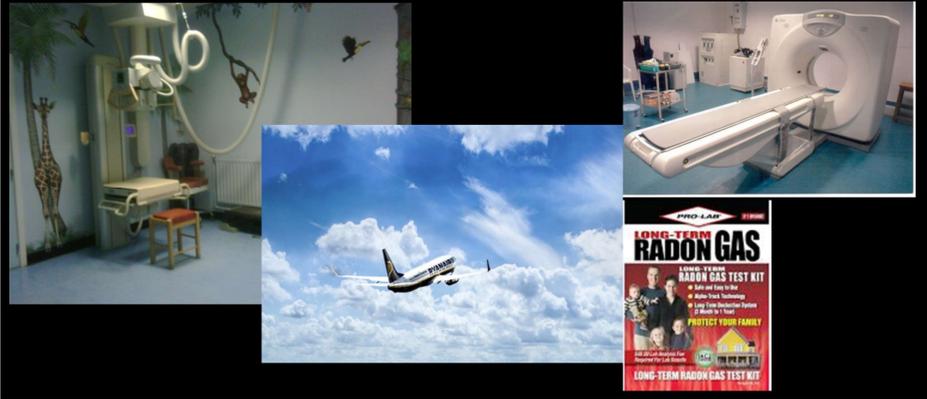
At this point, the only information given to decision makers is based on the blue circle of the Standard / Reference Man (blue circle). The rest of the information is effectively invisible.

DOSE RATE FACTORS

- Richardson, et al / BMJ 2015;351:h5359
- QUESTION: Do many small radiation exposures that add up to the same ONE BIG ONE show the same outcome (harm).
- ANSWER: YES.
- Data-Set INWORKS– Atomic workers from Europe and North America tracked for decades. Small exposures totaling A-Bomb survivor doses.
- Both Data-sets described by same linear-no-threshold risk model

Read slide

We add to natural background radiation



We add these little doses of radiation from medical and dental X-rays, CT-scans, high-altitude plane flight; radon build-up in our homes and industrial pollution.



Why is Gender a Factor in Radiation Harm?

Females have 50% more
high-risk tissue
compared to males



Here we come to the question of WHY?

No one is asking that question, let alone answering it.

Since the difference is greatest in young children we can rule out:

Body mass

Occupation

Adult behaviors

These factors have been suggested, but not yet tested:

Relative proportion of radio-sensitive reproductive tissue, or fatty tissue, or hormonal / metabolic factors.

Lots of questions to ask and answer!

Art Credit:

Dave Shannon



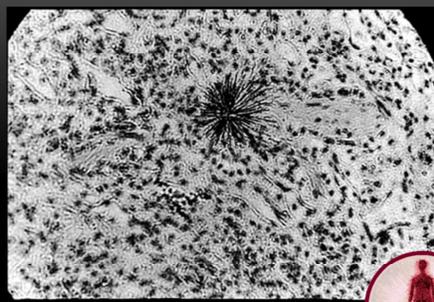
But the information we have now is sufficient for action. People have a right-to-know, to make better decisions and we need to offer greater protection and prevention while research continues.



A-Bombs: One fast pulse of external ionizing radiation – like an X-ray



Medical X-Ray image



Plutonium particle in lung tissue



Another question not tackled in this work to date:

IS Gender a factor in the harm from internalized radioactivity where the emissions are inside the body?

The Hibakusha all suffered a large flash of acute radiation from outside their bodies. The workers studied by Richardson were tracked for external radiation exposure. These exposures are more like the medical X-ray on the LEFT.

The photo on the right side shows plutonium in lung tissue. Fission products like Cesium and Strontium and Plutonium —that contaminate air, water and food – get inside the body. Radioactivity inside our bodies causes very different impacts.

The black areas are dead cells from very high local radiation exposure from radioactive particle emissions at close range. This is very different from X-rays.

We have no data tracking internal exposures across age and gender.

Photo Credit:

Left side: International Atomic Energy Agency.

Right side: Robert del Tredici, used by permission

BRIGHT LINE—ABOVE IS EMPIRICAL DATA

- **Below is projection / hypothetical**
For purposes of stimulating discussion

BRIGHT LINE

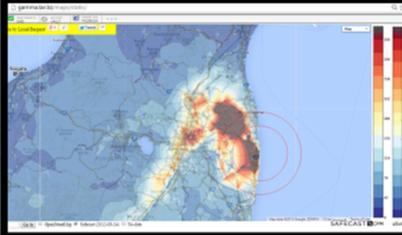
The following two slides are hypothetical and for purposes of providing stimulation on how we move forward in a more accurate approach to radiation assessment and evaluation.



Environmental Contamination: Chernobyl and Fukushima



40% of Europe contaminated above 4,000 Bq / m²
by Chernobyl reactor explosion in 1986



Gamma levels in proximity to Fukushima Daiichi, map
constructed by Lionel Bergeret from SAFecast data

Major reactor accidents contaminate large areas of land and water.

On the left is a different reconstruction of the cesium contamination from Chernobyl.

On the right is a map of cesium deposition from Fukushima Daiichi, on a much more local scale.

The question is how do we take the information on a single exposure of 20 mSv (the A-bomb data) and apply it to a situation where there is a 20 mSv annual life-time exposure.

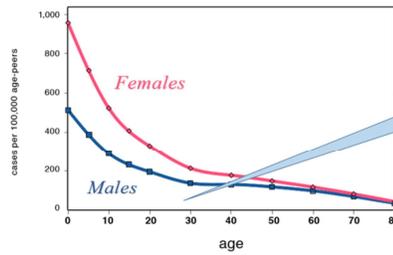
There are areas of the world where people are living and children are being born where 20 mSv a dose is credible.

SO I am presenting two approaches to this. Because is a hypothetical exercise for discussion there is no need to go back to the data. Application of the age-of-exposure cancer response curves is fine.

See safecast.org

Hypothetical Calculation: Lifetime annual dose of 20 mSv / year

Increased Cancer Risk by Age at Exposure to 20 mSv Radiation



Standard
Man risk: 1
fatal cancer
from 1 year
at 20 mSv

NRC expected: 7,000 fatal
cancers per 100,000 (1 in 14)
Females: 25,000 fatal cancers
per 100,000 (1 in 4)
Males: 12,500 fatal cancers
per 100,000 (1 in 8)

Follow the graph to create "Weighting Factors" for each year,
based on a known value.

First:

When the US national regulator converts the Reference Man risk to life-time exposure risk, they take the single risk-value and multiply by 70.

Knowing that assignment, we can generate both the expected outcome (fatal cancers) for the Reference Man, and also derive risk values for each other point on both of our age-response curves. These are then "weight factors" and since each cohort is 5 years, we apply these in 5-year increments across 70 years.

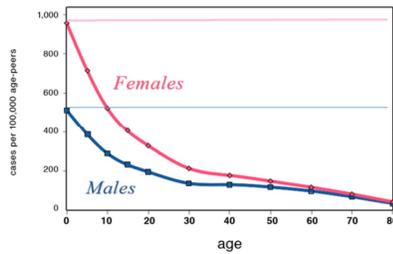
We end up with the following:

At 20 mSv a year, over a lifetime, the Reference Man will suffer fatal cancer at a rate of 1 in 14, per 100,000 people exposed.

An age-inclusive male will suffer at 1 in 8 and the age-inclusive female will suffer 1 fatal cancer in 4.

Scrap #1; SEE the original graph!
(60 years of data on each cohort)

Increased Cancer Risk by Age at Exposure to 20 mSv Radiation



U.S. National Academy of Sciences BEIR VII Phase 2 Risk Model

Exposure of young children to 20 mSv+ will dominate all other years

As I followed the work in the previous slide, the harm to children in the first 5 years was essentially DILLUTED by lower rate of harm in the later years.

The original graph is like a “freeze frame” in multiple dimensions. One exposure to 125,000 people, at the same time. Everyone who was exposed that day likely had little exposure to anything above “normal background”—they were under the second and third fission explosions.

The level of 20 mSv is considered “low” by the professionals, but is **twenty times** higher than typical, average “natural background.”

A single exposure in the first years in the Life Span Study projection remain and dominate for the entire life (60 years of data on each cohort.)

Being born into a contaminated area, or suffering radiation from some other source is effectively an “opportunity cost” on a healthy adulthood.



This is a picture of health:
These women have recently stopped a nuclear waste dump from being put on their People's Traditional lands.

Radiation prevention is more than avoiding harm. It is a source of health and empowerment.

See: <http://www.foe.org.au/muckaty-winnerz>



The future is in our hands.