

Fukushima Symposium: Radiation Exposure in Context

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Radiation-1

- Actually the environmental risk we know most about
- Huge amounts spent on large long-term cohorts with fantastic exposure assessment using excellent well-validated exposure metrics.
- Always more to learn, but very unlikely to be surprises
- Not weird, uncertain, insidious, hard to measure – when we do have such things on the platter
- No justification for application of precautionary principle, compared to many other agents.

Radiation-2

- Measurable across a huge spectrum of intensity – 12 orders of magnitude or more
- Partly because of its intrinsic nature
- Partly because of the unlimited funding behind it during the Cold War
- However, just because you can measure it, it does not mean it is dangerous
- This is a rephrasing of the basic exposure message – “Dose makes the poison”
- But lost in the fear of radiation

Radiation-3

- Standards are orders of magnitude more protective than for other major pollutants
- Amount spent per unit risk reduction orders of magnitude more than for other health protective measures
- In summary it is well understood and well measured and we spend large amounts to make sure we are very well protected.

And yet

- In California at least, there was near panic among some people because of the (very slightly) radioactive cloud approaching from Japan
- Why?

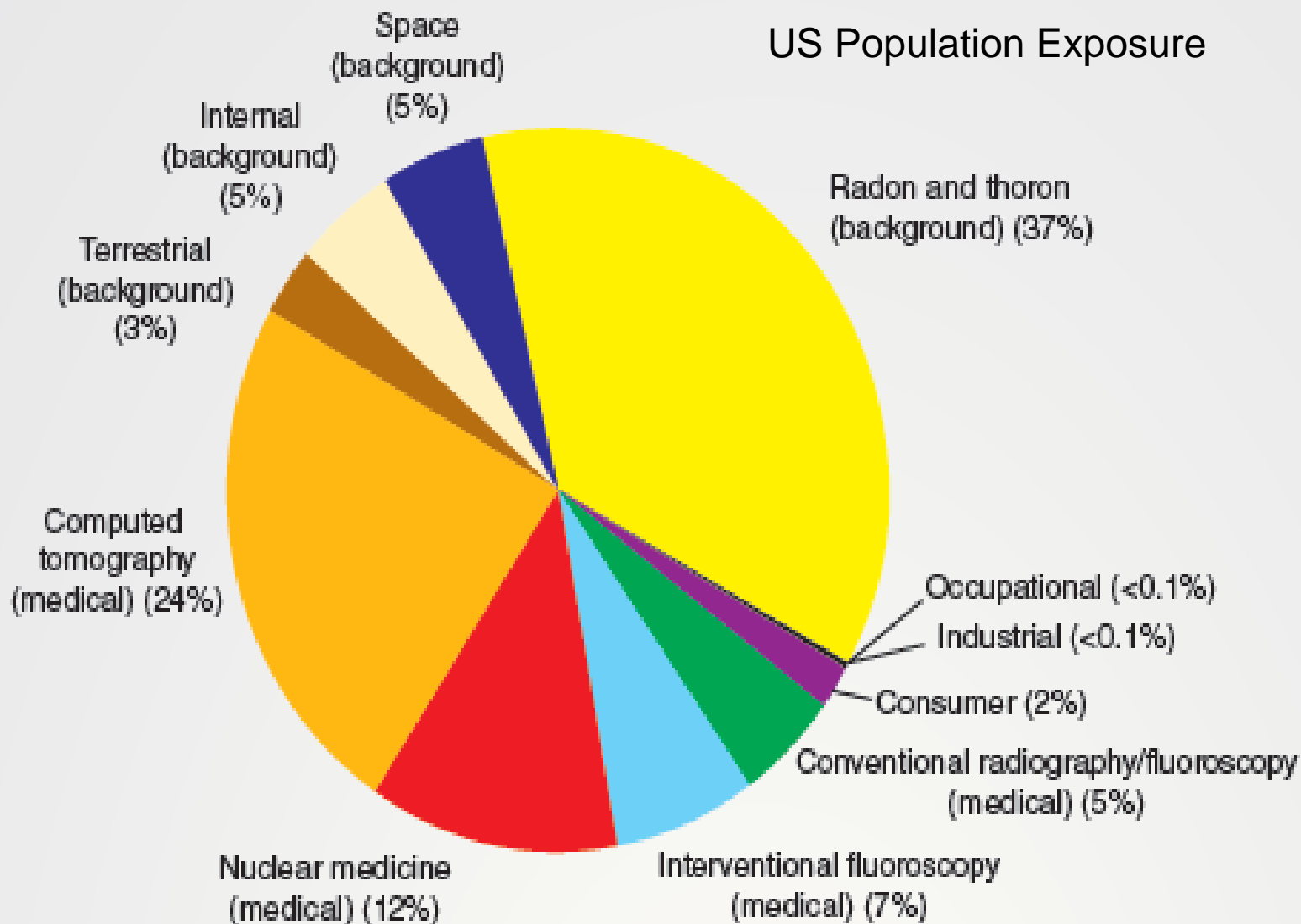
How do we compare-1?

- If everyone in the world lived inside the exclusion zone in Japan today for the next 70 years with no reduction in exposure rate
- The annual cancer impact would be ~10% of the annual impact of particle air pollution in the world
- Where should the exclusion zones be?
- On which side would you rather live?

How do we compare-2?

- The US standard for particle air pollution allows 50 times more mortality than the standard for public exposure to radiation from industrial activities
- But, many US communities exceed the PM standard and none are cleaner than 30%.
- However, the average actual radiation exposure (non-medical, non-radon) is far less than 1% of the standard
- Where should additional protection funding go?

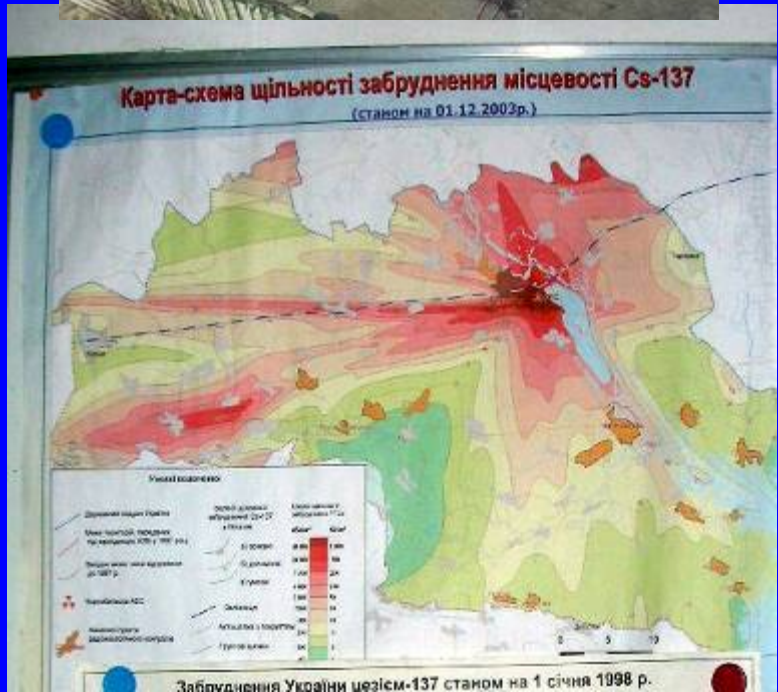
US Population Exposure



Total: 600 mrem/y = 6 mSv/y

NCRP, 2009

Consider Chernobyl



Chernobyl Reactor #4

April 2006

- Blew up during operation – nearly maximum radioactivity
- No containment
- Graphite core burned for days
- 95% of fission products released
- Plume extended into stratosphere
- Spread “across planet”
- Very late evacuation and distribution of iodine tablets by authorities
- About the worst nuclear power plant accident imaginable
- But how bad was it?

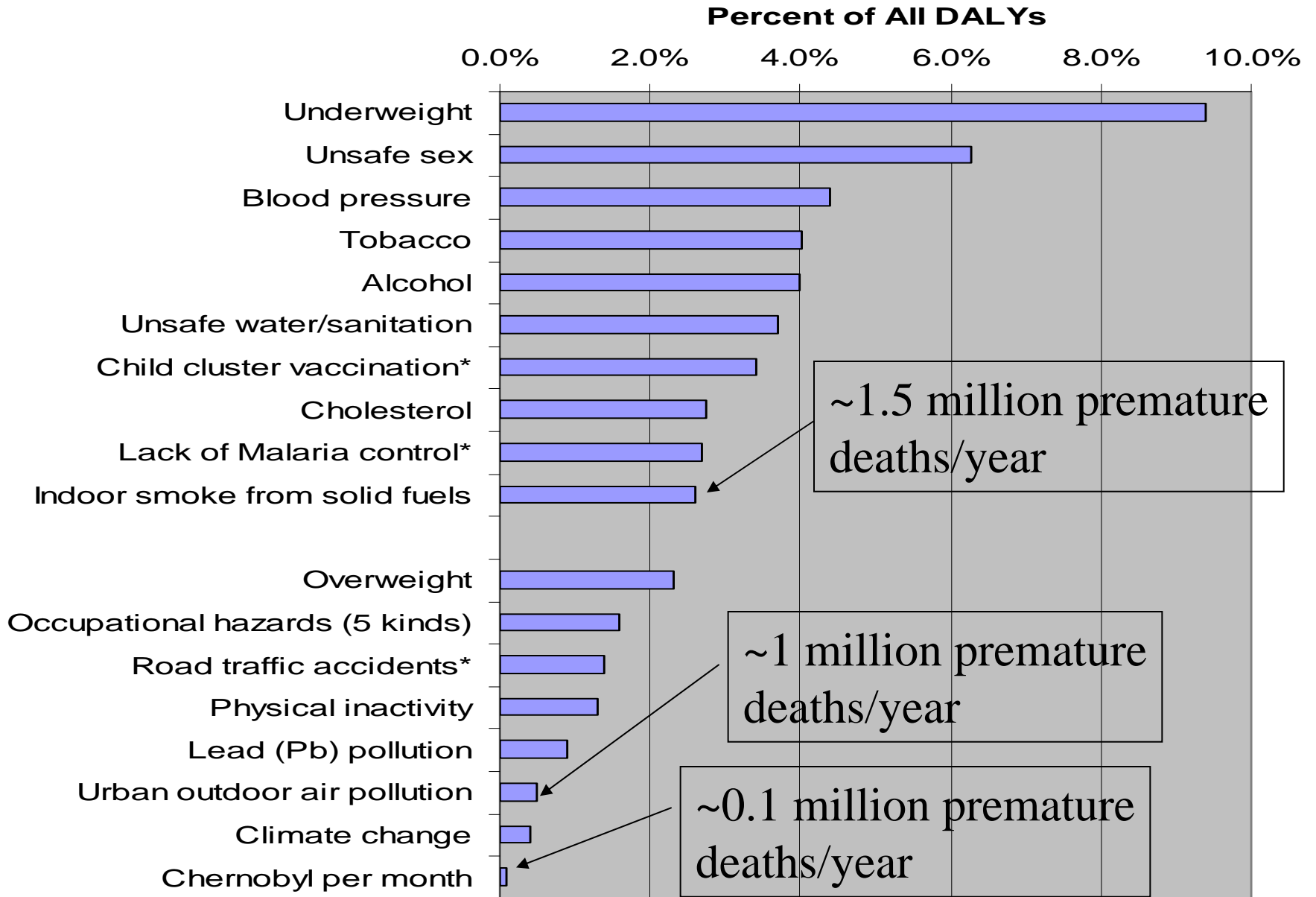
Report on Chernobyl

- A total of up to 4000 people could eventually die of radiation exposure from the Chernobyl nuclear power plant accident..., an international team of more than 100 scientists has concluded.
- As of mid-2005, however, fewer than 50 deaths had been directly attributed to radiation from the disaster, almost all being highly exposed rescue workers, many who died within months of the accident but others who died as late as 2004.
- About 4000 cases of thyroid cancer, mainly in children and adolescents at the time of the accident, have resulted from the accident's contamination and at least nine children died of thyroid cancer.
- The survival rate among such cancer victims ...has been almost 99%.

A Chernobyl Accident Per Month

- This would be about 0.3% of all reactors every year
- Some estimates of eventual mortality are higher than the 4k in the WHO/IAEA/UNDP report
- Thus, even though no reactors of the poor design of Chernobyl will ever exist again,
- Let's assume 10k deaths for each accident

Global Burden of Disease from Top 10 Risk Factors plus selected other risk factors



Of course, if there were a Chernobyl every month

- All nuclear power plants would probably be shut down in 3 months
- If not faster
- Meanwhile, coal power plants, traffic pollution, household air pollution, and so on kill millions
- Every year
- What should people be worried about?

Life Exposed:

**Biological
Citizens after
Chernobyl**

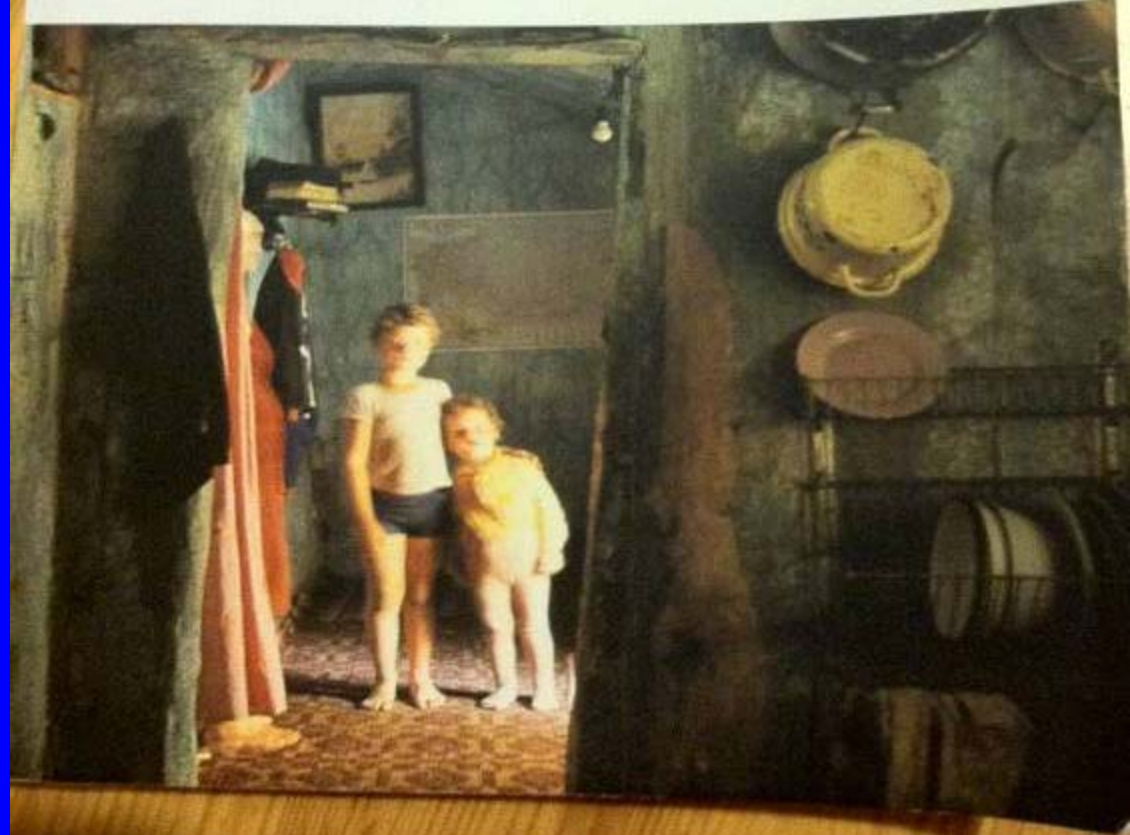
**Adriana
Petriana**

**Princeton University
Press, 2002**

ADRIANA
PETRYNA

Life
Exposed

Biological Citizens
after Chernobyl



Report on Chernobyl, cont.

- Relocation proved a “deeply traumatic experience” for some 350,000 people moved out of the affected areas. Although 116 000 were moved from the most heavily impacted area immediately after the accident, later relocations did little to reduce radiation exposure.
- Persistent myths and misperceptions about the threat of radiation have resulted in “paralyzing fatalism” among residents of affected areas.

What is our responsibility-1?

- Clear that radiation itself is not a major health hazard under normal conditions
- Or even not that bad after the worst possible nuclear power accidents, compared to alternatives.
- Also that protecting ourselves against radiation is immensely expensive per unit risk reduction compared to other environmental hazards – 100x at least
- Is it our responsibility to point this out – to shift resources to protective actions that will actually and significantly affect health?

What is our responsibility-2?

- If our new paradigm of exposure science stretches beyond “agents” to “stressors,” including stress itself, fear, disruption, uncertainty, inequity, etc.
- Don’t we then have the responsibility to reduce these stressors by working to reduce the misinformation about and over-reaction to radiation?
- In spite of public perceptions.

Finally

- Society is paying us to identify environmental hazards that are under controlled.
- But doesn't that imply that they also expect us to identify where society is creating unnecessary fear and cost by over-regulating some risks?
- Does not just apply to radiation.
- Not a culture of this among our profession

Many thanks



Prypat, 3 km from Chernobyl
June 2009
(exposure rate = flying at 10k meters)

Addendum re Nuclear Power

- As explored in some detail in the forthcoming *Global Energy Assessment-2011*, in press,
- The most intractable long-term risks from nuclear power are those associated with diversion/theft of fissionable materials from the front and back end of the fuel cycle.
- These are profound and extremely difficult to mitigate.
- Radiation from routine or accidental releases from the operation of nuclear power systems or from waste disposal are smaller by comparison as they in comparison to coal power systems, the chief alternative.