

# Understanding the Fukushima Radiation Panic

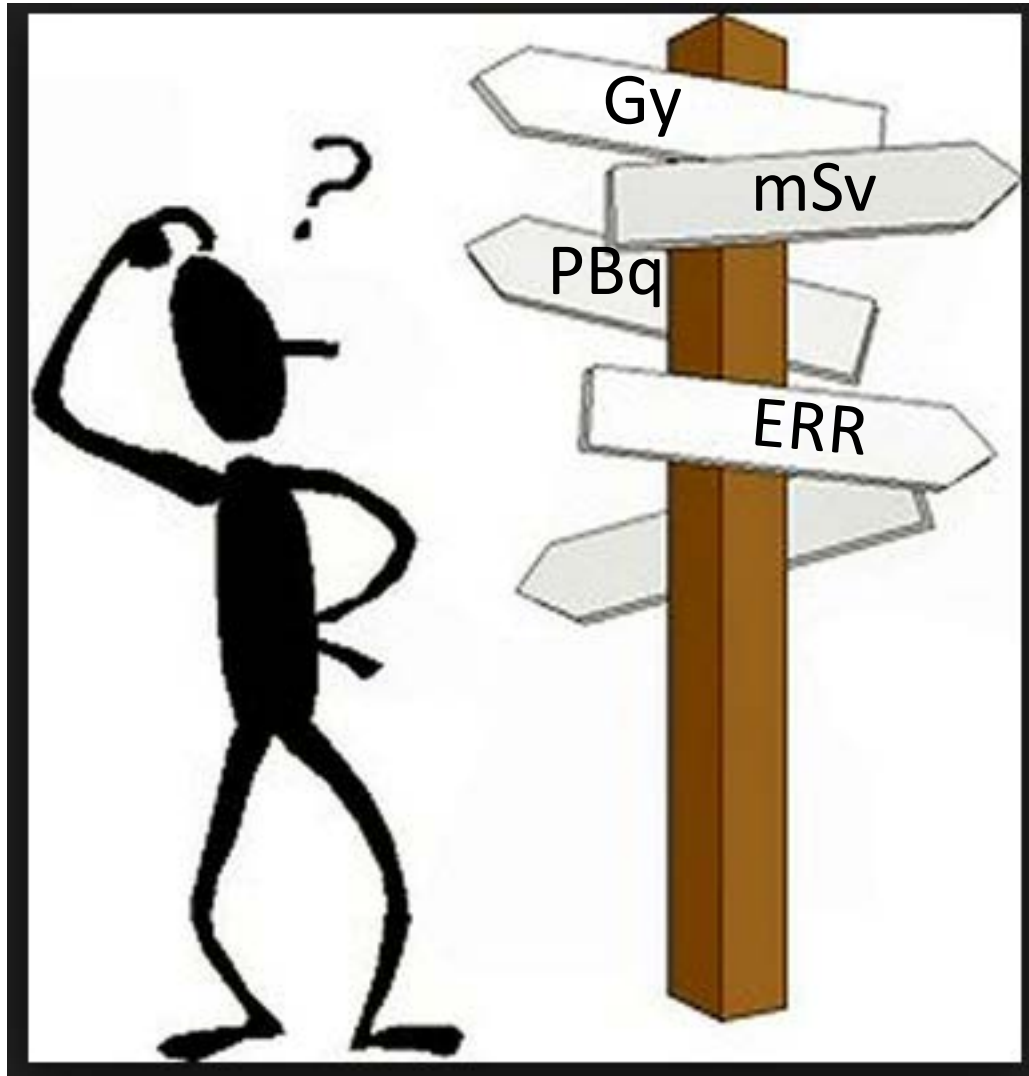
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# The problem with radiation....

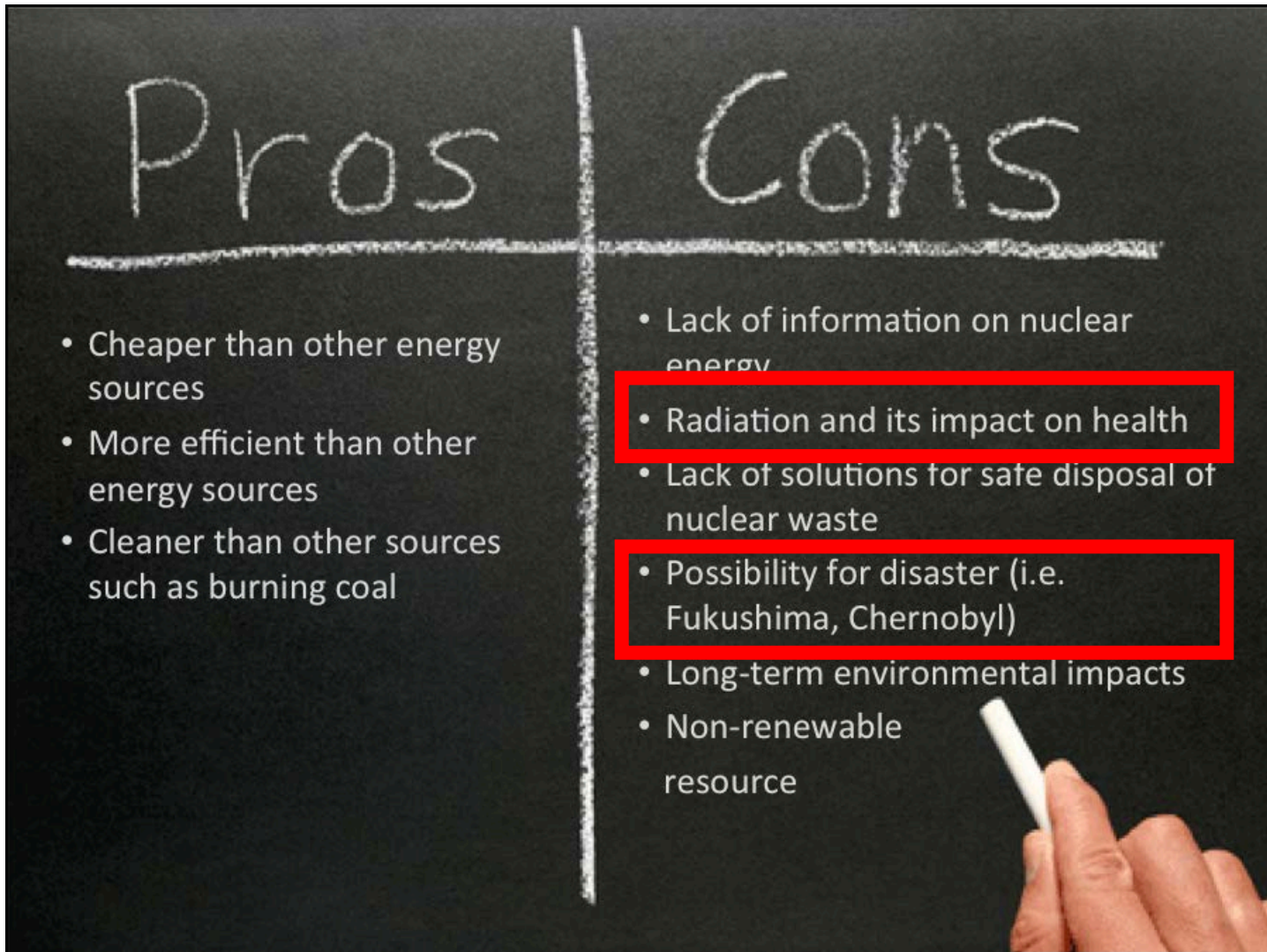


- Long history of being made to fear radiation (from atomic weapons)
- General acceptance of medical radiation exposure, and exposure to natural radiation (e.g. Spas) believed to be beneficial
- Relationship between dose and response to all toxins (including radiation)
- Individual dose from radiation in the environment depends on many factors
- Perception that individual dose from nuclear accidents is much higher than it is

# The problem with radiation risk communication



- Too much jargon
- Political football
- Lots of misinformation and very little understandable science
- Constant emphasis on safety – **must be unsafe**



Pros	Cons
<ul style="list-style-type: none"><li>• Cheaper than other energy sources</li><li>• More efficient than other energy sources</li><li>• Cleaner than other sources such as burning coal</li></ul>	<ul style="list-style-type: none"><li>• Lack of information on nuclear energy</li><li>• Radiation and its impact on health</li><li>• Lack of solutions for safe disposal of nuclear waste</li><li>• Possibility for disaster (i.e. Fukushima, Chernobyl)</li><li>• Long-term environmental impacts</li><li>• Non-renewable resource</li></ul>

Ipsos Mori 2014 - >21,000 people in 23 countries

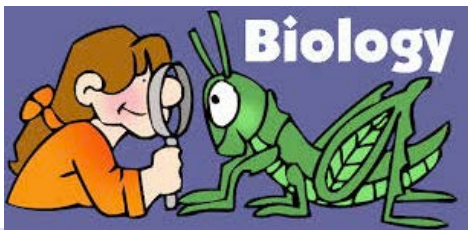
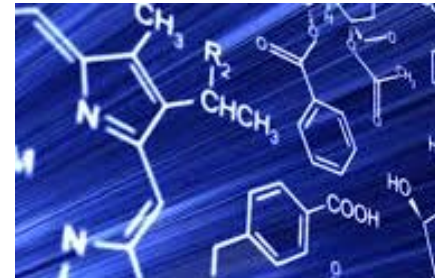
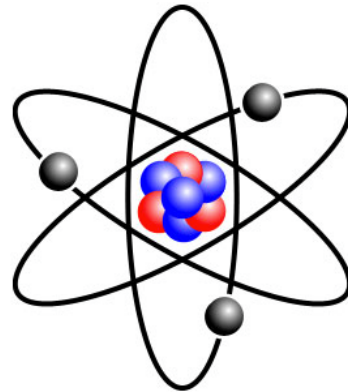
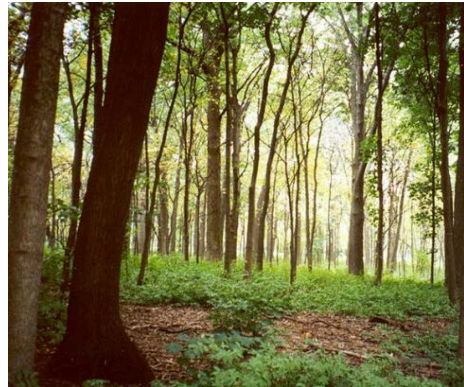
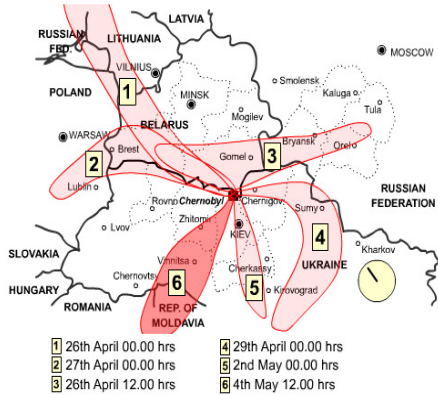
# Radiation releases in perspective



	131-I	137-Cs
A-bomb tests in 1960s	675,000 PBq	948 PBq
Chernobyl	1,760 PBq	85 PBq
Fukushima	100-500 PBq	6-20 PBq

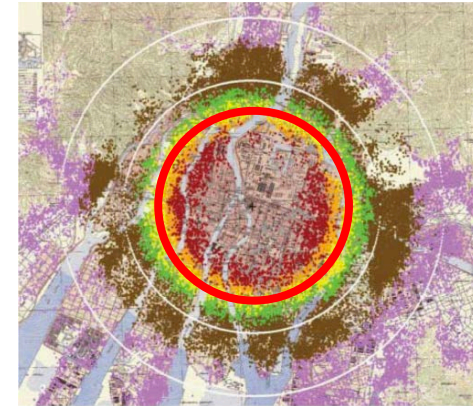
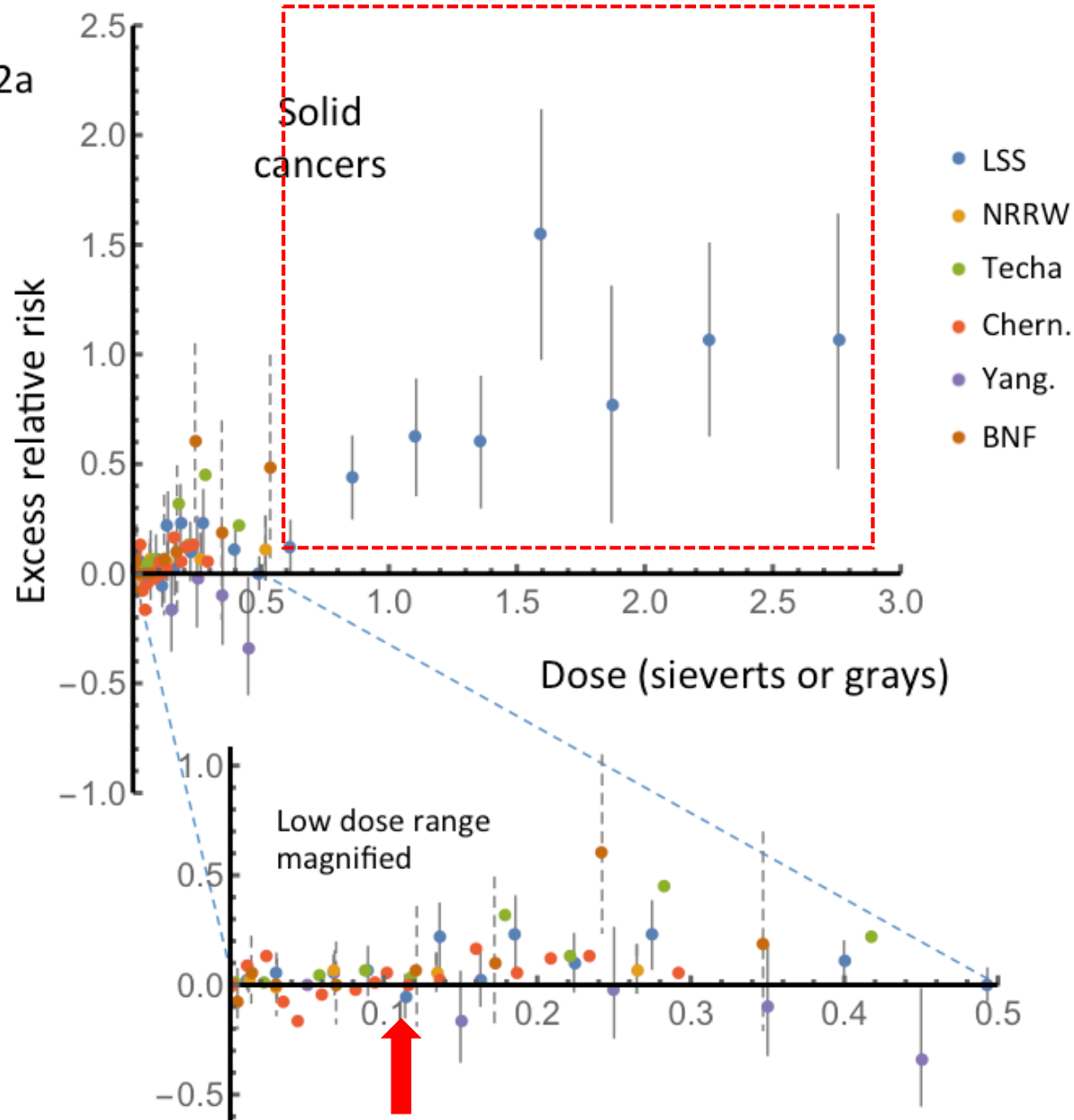
Sources: [www.unscear.org/docs/reports/2008/11-80076 Report 2008 Annex D.pdf](http://www.unscear.org/docs/reports/2008/11-80076_Report_2008_Annex_D.pdf)  
[http://www.unscear.org/docs/reports/2013/13-85418 Report 2013 Annex A.pdf](http://www.unscear.org/docs/reports/2013/13-85418_Report_2013_Annex_A.pdf)

# Health effects dependent on dose to tissues



$$P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$$

Figure 2a



Rings represent 2 and 3 km from epicenter  
 Red >1000mGy  
 Orange 500-1000mGy  
 Yellow 200-500mGy  
 Green 100-200 mGy  
 Brown 5-100 mGy  
 Pink <5 mGy

Douple et al., doi:  
 10.1001/dmp.2011.21

McClellan et al., Proc. R. Soc. B (2017) 1070. <http://dx.doi.org/10.1098/rspb.2017.1070>

# What does this mean for us?



Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2. Washington, DC: National Research Council; 2005. National Research Council, Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation.



# Increased risk of mortality



Megacity versus small town living **2.8%**

Passive smoking **1.7%**

Exposure of 250mSv (Chernobyl  
Liquidator) **1.0%**

Exposure of 100mSv (Chernobyl  
Liquidator) **0.4%**

Source: Smith J BMC Public Health 2007 7:49

# The Public and Nuclear Accidents

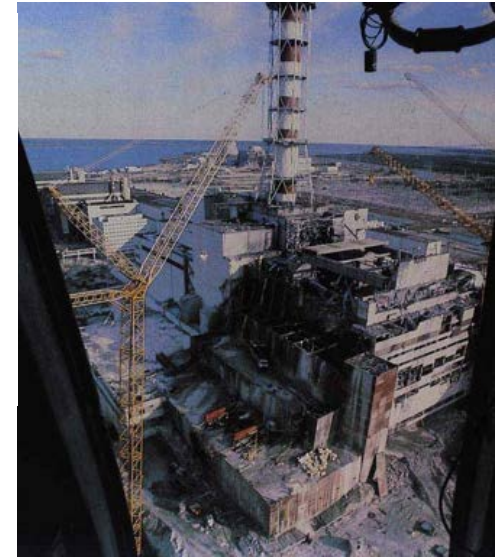


## Living with the fallout of Chernobyl 30 years later: Harrowing photographs show children living 40 miles from site of world's worst nuclear disaster and 'still suffering radiation effects'

- Thirty years after the Chernobyl nuclear disaster, high rates of health conditions remain for those living nearby
- Children in the area are still born at greater risk of immune system deficiencies and heart rhythm disorders
- Adults living near the decommissioned power plant also suffer higher rates of heart disease and thyroid cancer

By COREY CHARLTON FOR MAILONLINE

PUBLISHED: 12:15 GMT, 12 April 2016 | UPDATED: 06:54 GMT, 13 April 2016



# Public Perception of Radiation – myth and reality

## New Book Concludes – Chernobyl death toll: 985,000, mostly from cancer



<http://www.globalresearch.ca/new-book-concludes-chernobyl-death-toll-985-000-mostly-from-cancer/20908>

### 2065 toll

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The mainstream view puts the toll in five figures. Environmental physicist **Jim Smith** of the University of Portsmouth, UK, prefers to cite a 2006 study by **Elisabeth Cardis** of the International Agency for Research on Cancer in Lyon, France. This predicted that by 2065 Chernobyl will have caused about 16,000 cases of thyroid cancer and 25,000 cases of other cancers, compared with several hundred million cancer cases from other causes.

<http://www.newscientist.com/article/dn20403-25-years-after-chernobyl-we-dont-know-how-many-died.html>

# Health Effects of Nuclear Power Plant accidents



- The radionuclides of concern for the population at large are  $^{131}\text{I}$  and  $\text{Cs-137}$
- The likely health effects are determined by the dose of radiation delivered by these isotopes to tissues in the body
- Low dose = smaller health effect, large dose = larger health effect
- The dose to an individual can be affected by many different things – what they were doing, their diet etc

- $^{131}\text{I}$  has a short physical half-life of 8 days, but concentrates in the thyroid. Its biological half life is approx 100 days
- $^{137}\text{Cs}$  has a longer physical half-life (30 years), is not concentrated in any tissue in the body. Its biological half-life is also approx 100 days
- Doses to individual tissues are lower from  $^{137}\text{Cs}$  than  $^{131}\text{I}$

# Chernobyl - doses from 131-I

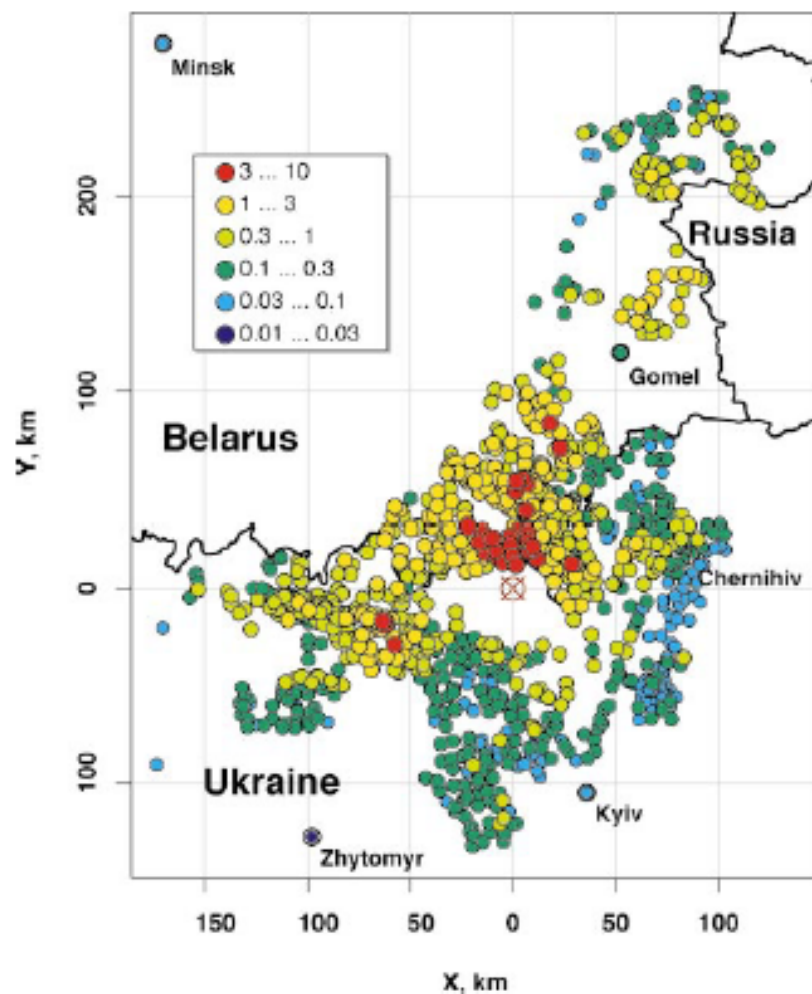


FIG. 1. Average thyroid dose (Gy) of the birth cohort 1968–1985 in the 608 Ukrainian and 426 Belarusian study settlements. The Chernobyl nuclear power plant is indicated in the center of the map.

Total number of direct thyroid measurements in literature 160,000.  
individual dose assessments 27,000.  
Range of doses <1Gy to 60 Gy

Jacob P et al., Radiation Research  
165, 1–8 (2006)

# Chernobyl - doses from Cs-137

- Average dose to residents in contaminated areas of Belarus, Ukraine and Russia 1986-2005 from exposure to Cs-137 was 10 mSv



- 28 from Acute Radiation Syndrome
- **15 deaths from thyroid cancer in 25 years**
- **4000 - 16,000 excess thyroid cancers in total predicted. 1% mortality rate = 40-160 deaths attributable to radiation over 80 years**
- **No (scientific) evidence of increased thyroid cancer outside 3 republics**
- No effect on fertility, malformations or infant mortality
- No conclusion on adverse pregnancy outcomes or still births
- Heritable effects not seen and very unlikely at these doses
- No conclusive evidence of increase in any other cancer even in liquidator cohorts)

Source: [www.unscear.org/docs/reports/2008/11-80076\\_Report\\_2008\\_Annex\\_D.pdf](http://www.unscear.org/docs/reports/2008/11-80076_Report_2008_Annex_D.pdf)



- Only health consequence from the physical exposure to radiation from Chernobyl has been thyroid cancer in children
- Due to exposure to high thyroid doses (>100 mSv) of <sup>131</sup>I in fallout
- **Most damaging health effect has been psychological stress due to fear of radiation exposure**

Source: [www.unscear.org/docs/reports/2008/11-80076\\_Report\\_2008\\_Annex\\_D.pdf](http://www.unscear.org/docs/reports/2008/11-80076_Report_2008_Annex_D.pdf)

# Fukushima vs Chernobyl



- Mean doses to thyroid have been measured as 4.2 mSv: 100 fold less than in Chernobyl evacuees
- 93% of residents (both evacuees and still resident) in Fukushima had estimated doses of less than 2mSv in first 4 months post accident
- Measured doses were around half of this
- WBC at later time points show the majority of people have no detectable levels of Cs-137.

- Japanese authorities initiated a large population based health survey in 2011
- Thought that this would allay public fears
- Difficult to separate radiation consequences from health consequences of societal disruption
- Large scale ultrasound screening of the thyroid of population aged under 20 at the time of the accident

# Thyroid cancer and Fukushima?



NEWS • ASIA • JAPAN

## Rise in childhood cancer in Fukushima sparks debate

Three years after the worst nuclear accident in a generation, the Japanese prefecture is reporting a rise in the number of children showing cancer symptoms

The Guardian in Fukushima

PUBLISHED : Monday, 10 March, 2014, 10:47am

UPDATED : Monday, 10 March, 2014, 12:37pm



AP / October 8, 2015, 11:50 AM

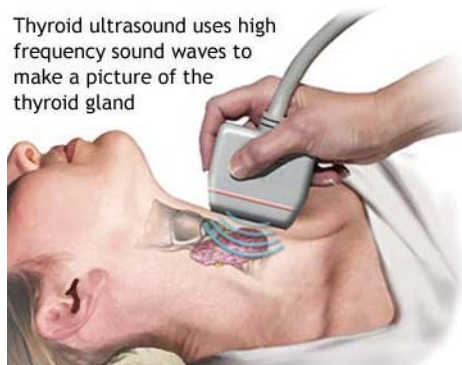
## Study finds higher cancer rates in kids near Fukushima

# Thyroid screening – how you look matters

## Incidence of nodules



2-6%



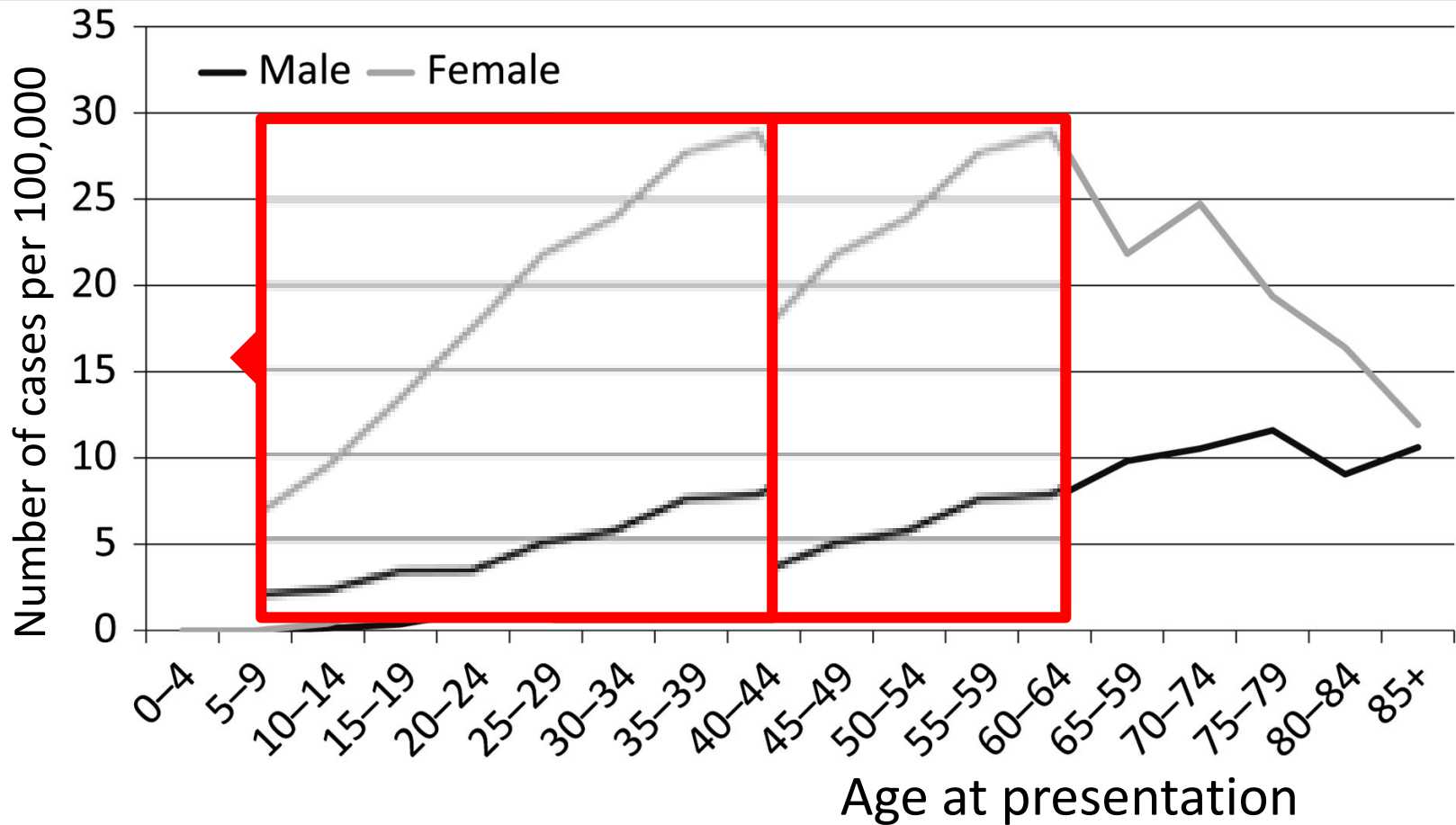
19-35%



8-65%

Dean and Gharib Best Practice & Research Clinical Endocrinology & Metabolism Vol. 22, No. 6, pp. 901–911, 2008  
doi:10.1016/j.beem.2008.09.019

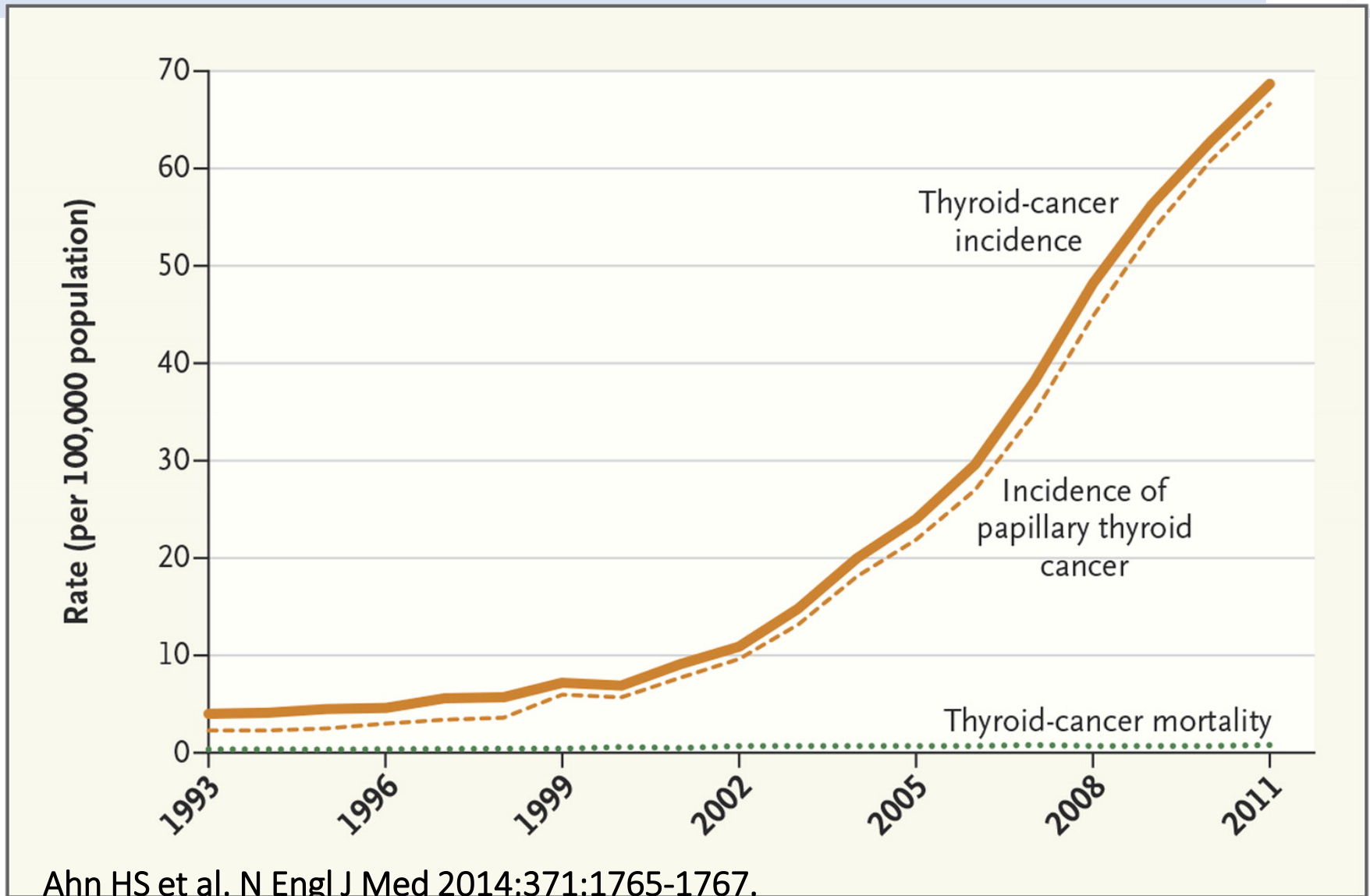
# Thyroid cancer and age at diagnosis - Japan (non-screened population)



Kumiko Saika et al. *Jpn. J. Clin. Oncol.*  
2014;44:1131-1132

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# Effect of screening - Korea

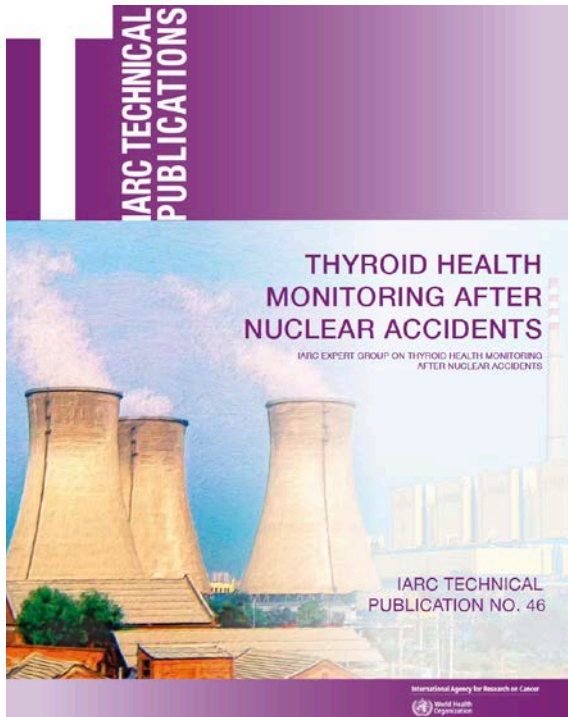


# What have we learned?

## Expert Group recommendations:

1: No population- based thyroid screening after a nuclear accident.

2: Consideration should be given to offering a long term thyroid monitoring programme for higher risk individuals after a nuclear accident.



<http://publications.iarc.fr/571>

[Lancet Oncol.](#) 2018 Oct;19(10):1280-1283. doi: 10.1016/S1470-2045(18)30680-6.



- Some sections of the population state that they are worried about acute radiation syndrome and transgenerational effects
- The **scientific** evidence indicates that this will not occur
- Scientists and the media should work together to dispel the myths that surround the effects of low doses of radiation on health – or the opinions of pseudoscientists will prevail

- No radiation related deaths compared with >1500 who died as a result of the evacuation or stress related to it, and approx 20,000 in tsunami
- Increases in thyroid cancer or any other cancer not discernible at these low doses
- Psychological harm due to evacuation and radiophobia
- Huge economic effect on local area and Japan as a whole

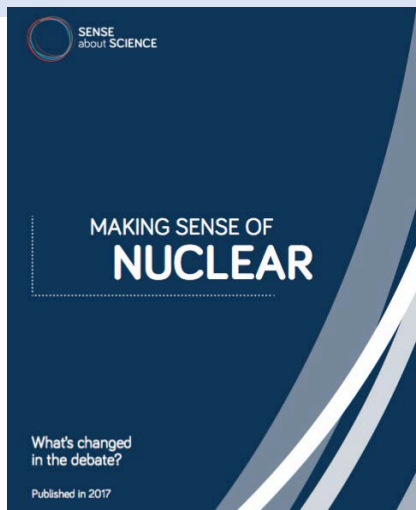
Sources: <http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf>  
[http://www.unscear.org/unscear/en/publications/Fukushima\\_WP2017.html](http://www.unscear.org/unscear/en/publications/Fukushima_WP2017.html)

# Take home messages



- Health effects of radiation relate to dose
- Individual doses from nuclear accidents much lower than people believe
- An energy mix that favours nuclear and renewables over carbon based technologies will reduce the health consequences of particulate emissions and climate change
- If we want a modern society we need to generate electricity cheaply and reliably – **perhaps we should start to use scientific facts rather than urban myths to decide future energy policy**

# Further information



<http://senseaboutscience.org/wp-content/uploads/2017/06/making-sense-of-nuclear.pdf>

## PROCEEDINGS B

[rspb.royalsocietypublishing.org](http://rspb.royalsocietypublishing.org)

Review



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## A restatement of the natural science evidence base concerning the health effects of low-level ionizing radiation

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