

**Canadian Nuclear Society
Sheridan Park Branch
Mississauga, May 25, 2022**

**Distributing iodine pills links
nuclear plants to cancer**

**Dr. Jerry M. Cuttler, DSc, PEng
Cuttler & Associates
Toronto, Ontario**

Dr. Jerry M. Cuttler biography



Completed Engineering Physics at University of Toronto 1964.
M.Sc. in Nuclear Engineering 1968, D.Sc. Nuclear Sciences 1971
at Israel Institute of Technology.

From 1974, Atomic Energy of Canada Limited to design, procure
equipment and provide support for 25 nuclear reactors.

From mid-2000, consulting services through Cuttler & Associates.

From 1995, he collaborated with renowned medical scientists in
studies on applications of low doses of radiation in therapies for
cancer, infections, inflammations, and neurodegenerative diseases.



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Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 22-M6

Date signed/Signé le : 10 JANUARY 2022

Technical Briefing

Exposé technique

Potassium Iodide Pill Working Group – Phase I Report

Groupe de travail sur la pilule d'iodure de potassium – Rapport de phase I

Public Meeting

Réunion publique

Scheduled for:
January 26, 2022

Prévue pour :
26 janvier 2022

Submitted by:
CNSC Staff

Soumise par :
Le personnel de la CCSN



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada

<https://www.nuclearsafety.gc.ca/eng/the-commission/meetings/cmd/pdf/CMD22/CMD22-M6-A.pdf>



CMD 22-M6.A Potassium Iodide (KI) Pill Working Group – Phase I Report

CNSC Staff Presentation
January 26 – 27, 2022



e-Doc 6696665 (PPT)
e-Doc 6720713 (PDF)



Radiation has been used in medicine for over 120 years. It is a great benefit

From 1896, physicians used X-rays and radium to

- **treat cancer**
- **stop infections: sinus, inner ear, **pneumonia**, etc.**
- **relieve inflammations: arthritis, asthma, nasal adenoids in kids**

Recently, I worked on cancer, Alzheimer's, Parkinson's, and others

Studies of X-rays for inflammatory diseases

	Number of subjects	Successful treatment (%)	Studies (N)	References
Arthritis	>5000	~ 85	Cumulative experience	Kahlmeter ¹⁴ and Kuhns and Morrison ¹⁵
Bronchial asthma	~ 4000	75–80	57	Calabrese et al. ¹²
Carbuncles	187	60–90	5	Calabrese ⁶
Cervical adenitis	893	75–90	11	Calabrese and Dhawan ¹⁰
Deafness	15,000	>95%; performed prior to age 15	Cumulative experience	Crowe and Baylor ²²
Furuncles	420	75–95	5	Calabrese ⁶
Gas gangrene	365	Mortality rate decreased from 40% to 10%	13	Calabrese and Dhawan ⁷
Otitis media/mastoides	564	~ 90	16	Calabrese and Dhawan ¹⁰
Pertussis	~ 2400	~ 80	22	Calabrese et al. ¹³
Pneumonia	863	80–85	18	Calabrese and Dhawan ⁸
Sinus infection	4492	75–90	16	Calabrese and Dhawan ⁹
Tendonitis/bursitis	3333	70–90	31	Calabrese and Dhawan ¹⁰
	37,517			

Calabrese et al 2019: <https://doi.org/10.1177/0960327119846925>

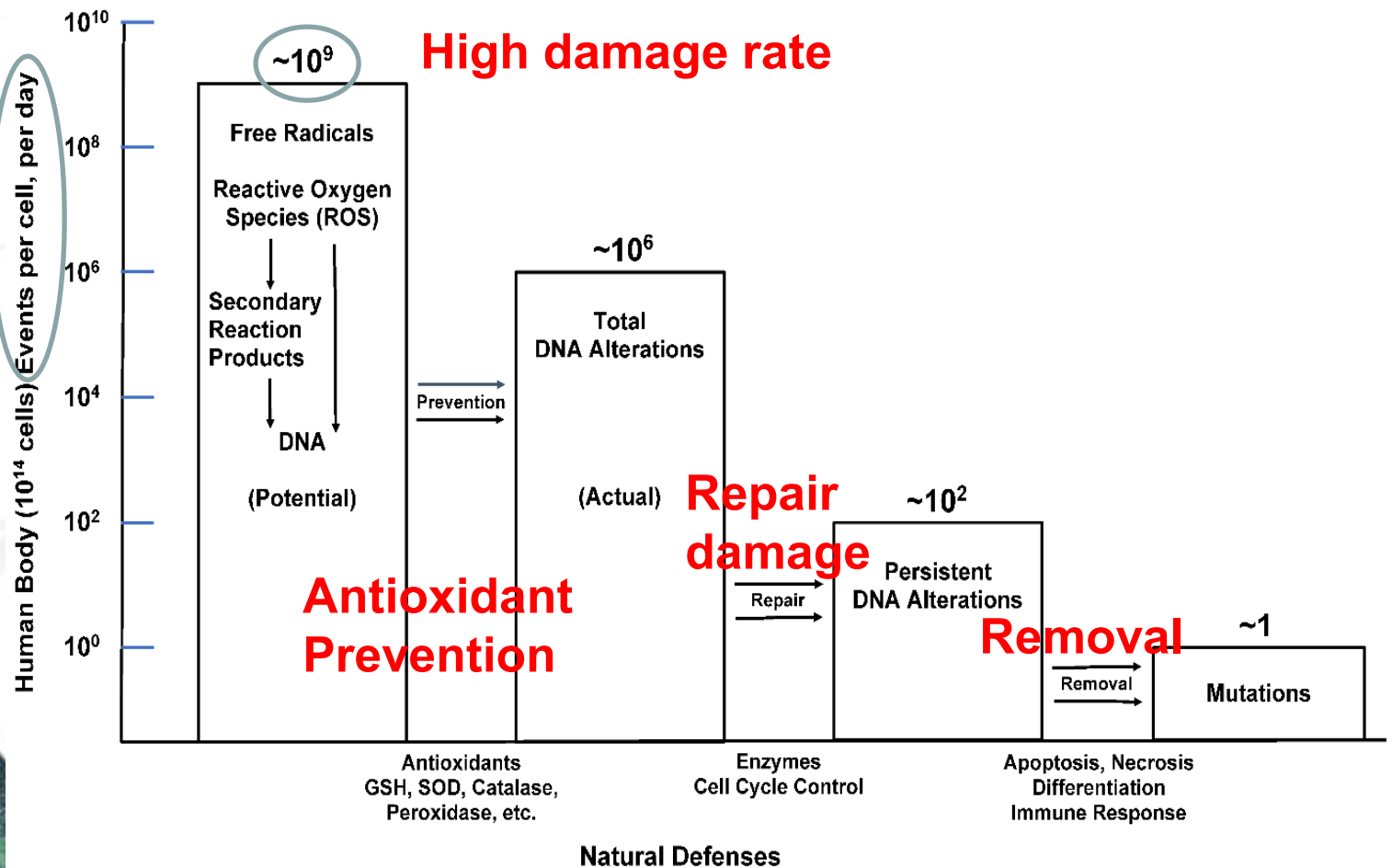


Protection systems cause recovery from disease

- Agents are needed for redox **cell-signaling**: O_2^- , H_2O_2 , others
- These agents are **reactive oxygen species** (ROS), made in cell mitochondria and elsewhere
- **ROS** cause oxidative damage to DNA at a very high rate
- Powerful **protection systems** act against oxidative damage and against other internal and external harmful effects and disease
- But the protection systems get weaker with **age**

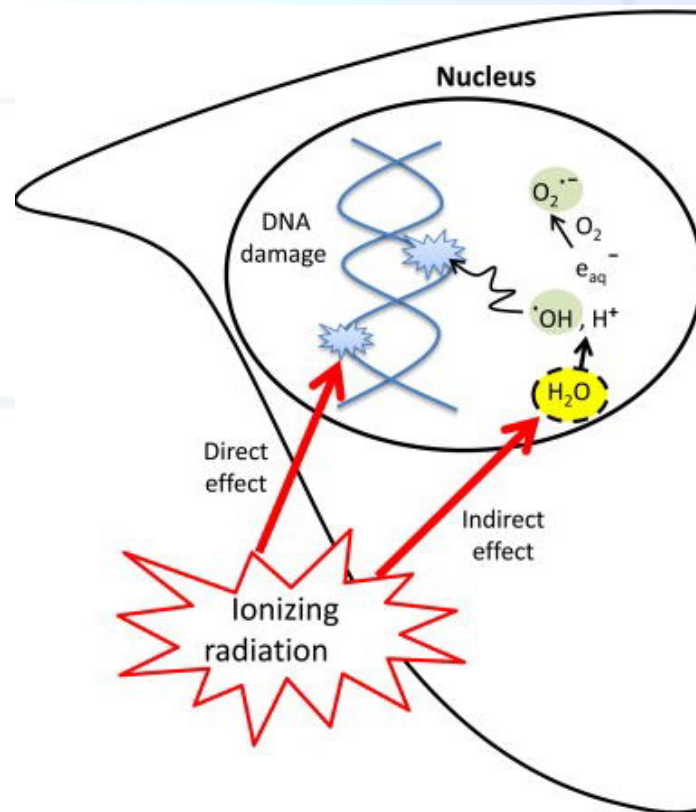
See very high DNA damage rate caused by ROS

Protection systems decrease damage enormously



A burst of radiation causes DNA damage

Direct hits damage DNA, and
Radiolysis of water makes ROS





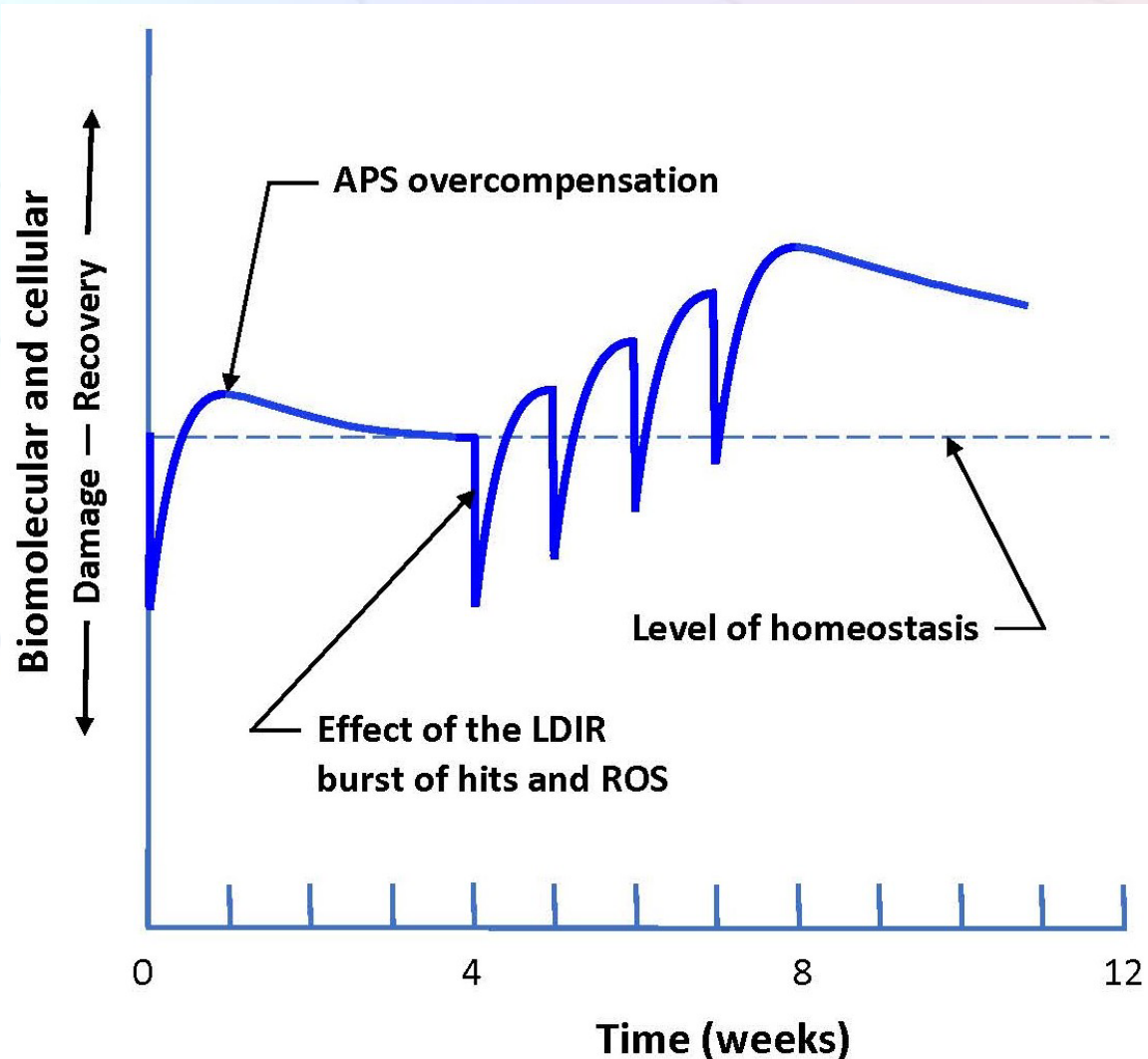
Fortunately, radiation is beneficial. It stimulates the protection systems!

- Each radiation burst causes the systems to **over-respond**
- So, recovery is **stronger** and **longer lasting**
- A **low** dose stimulates recovery against
 - oxidative damage and all internal illnesses
 - external infections, toxins, injuries, etc.
- But a **high** dose inhibits the protection systems

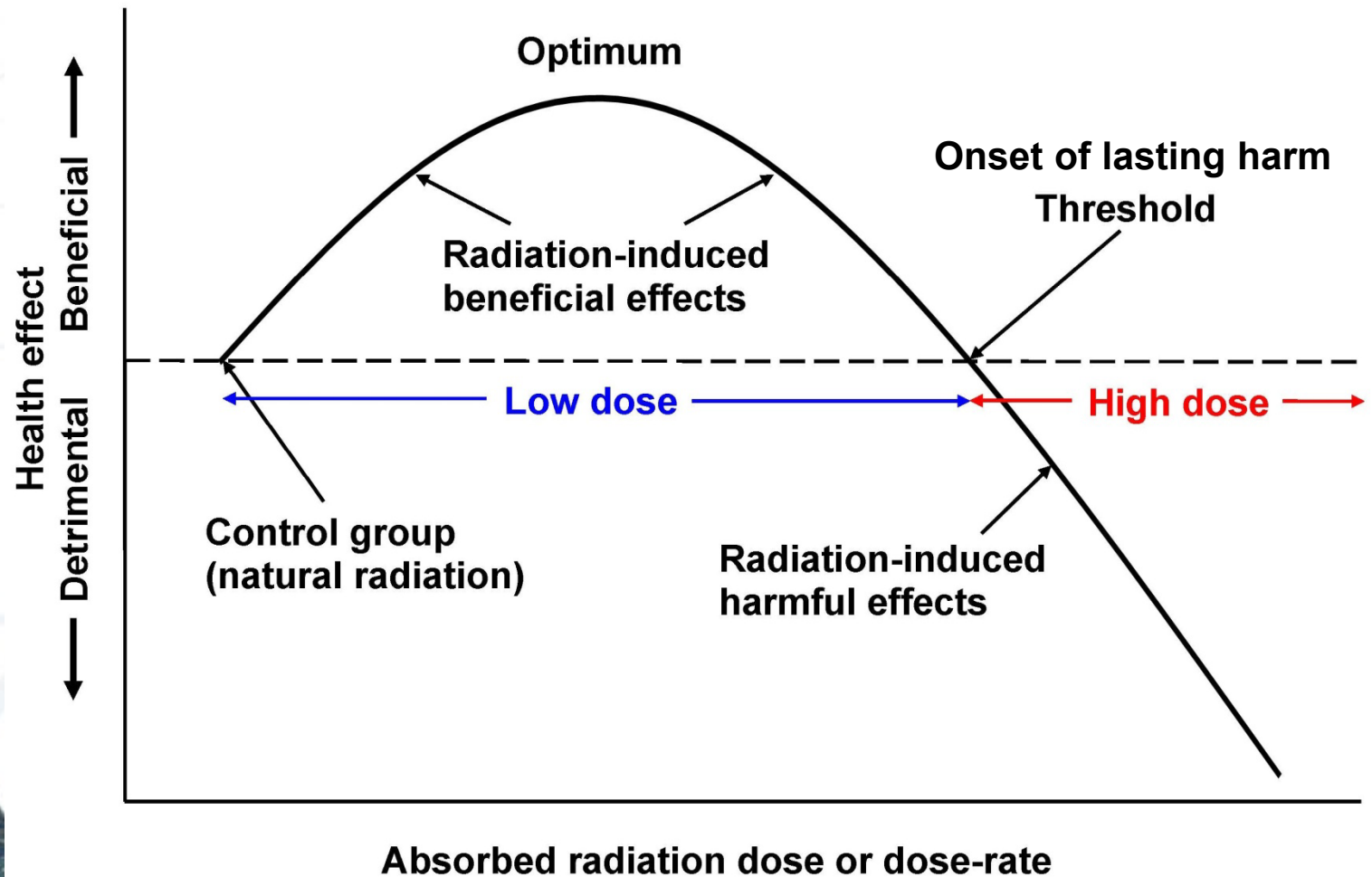
Single and repeated X-ray treatments

See over-recovery from one **low** dose burst

More doses give larger, more lasting recovery for disease and injuries

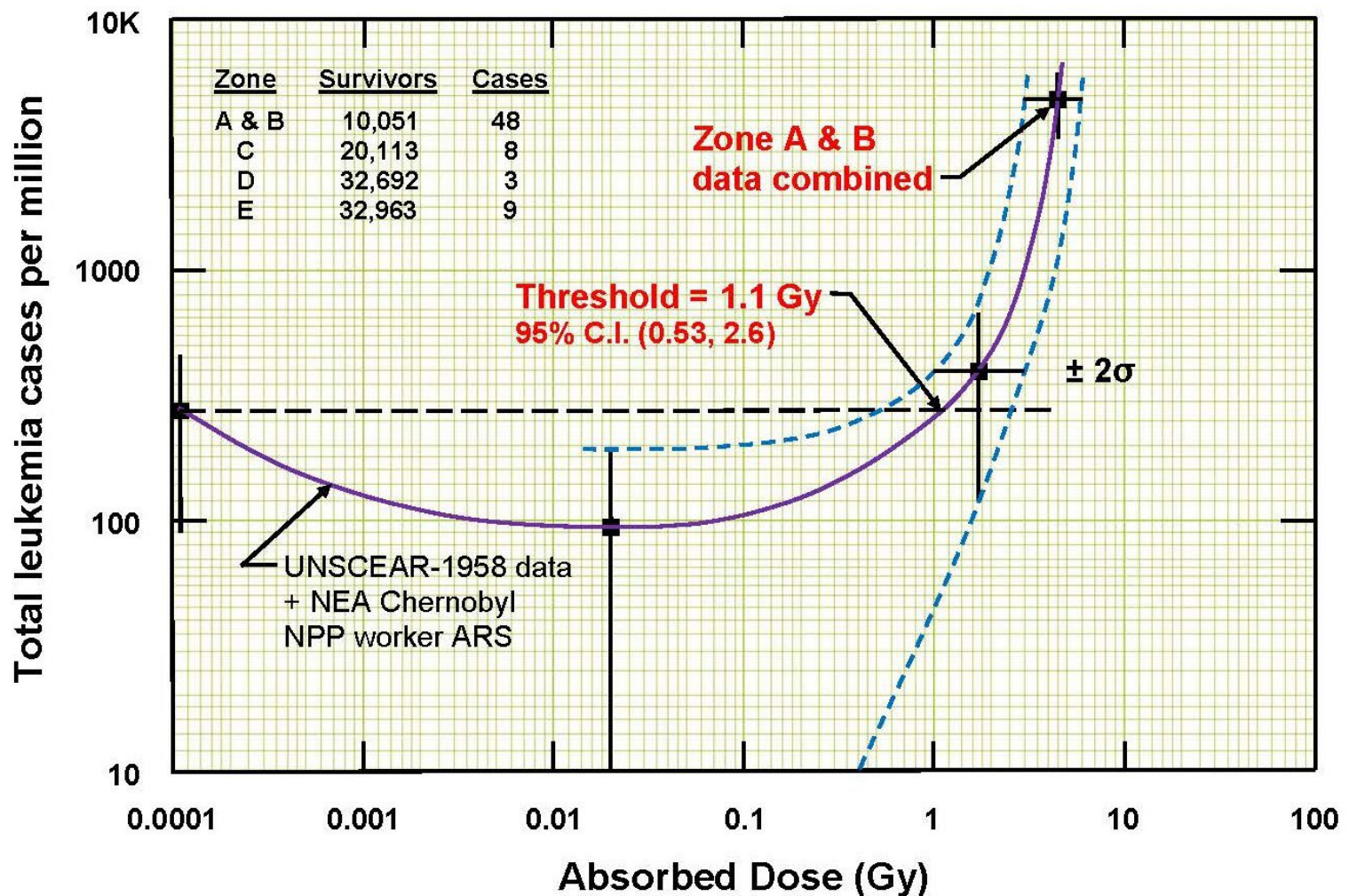


What is a low dose?



Dose-response model

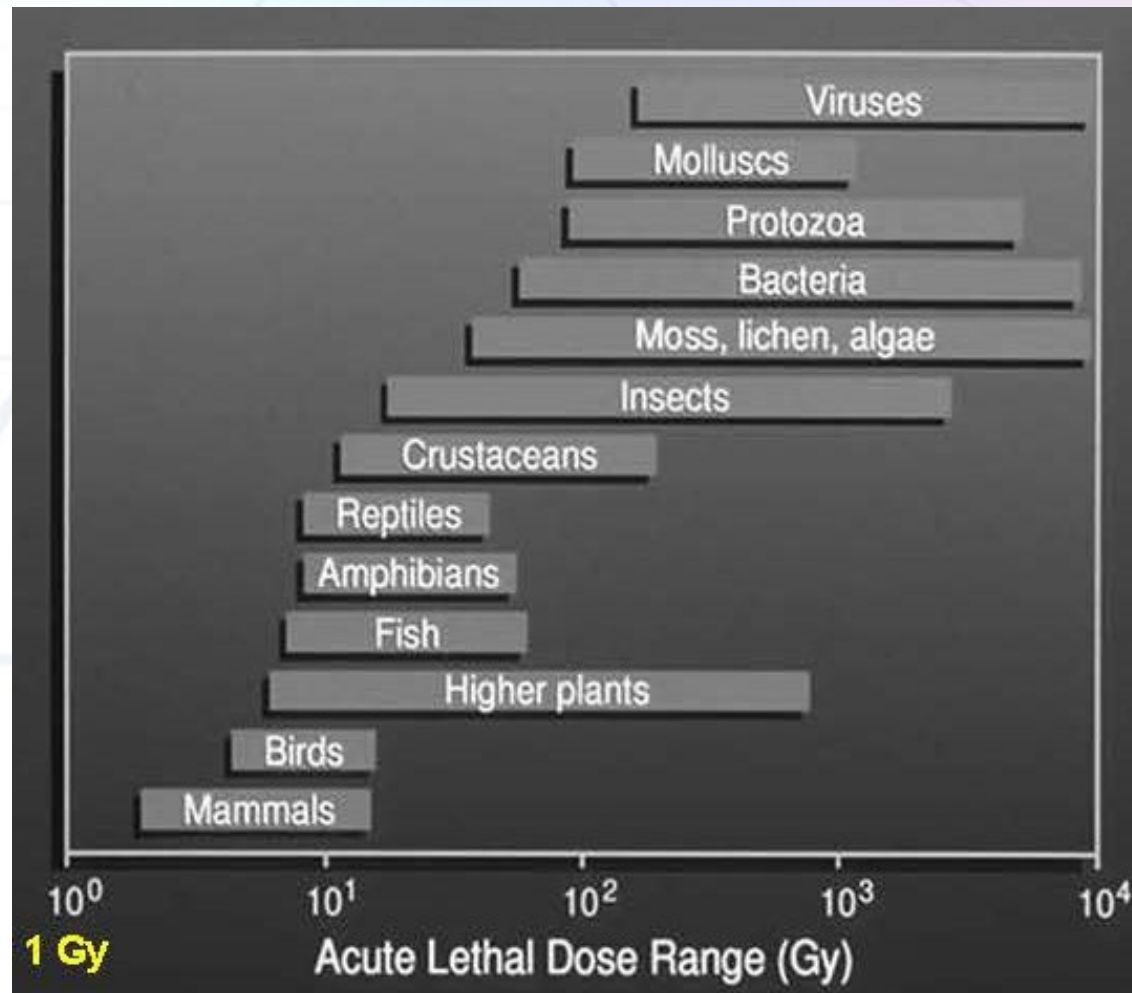
Threshold for radiation-induced leukemia after Hiroshima atomic bomb Aug 1945



Is radiation a major cause of cancer?

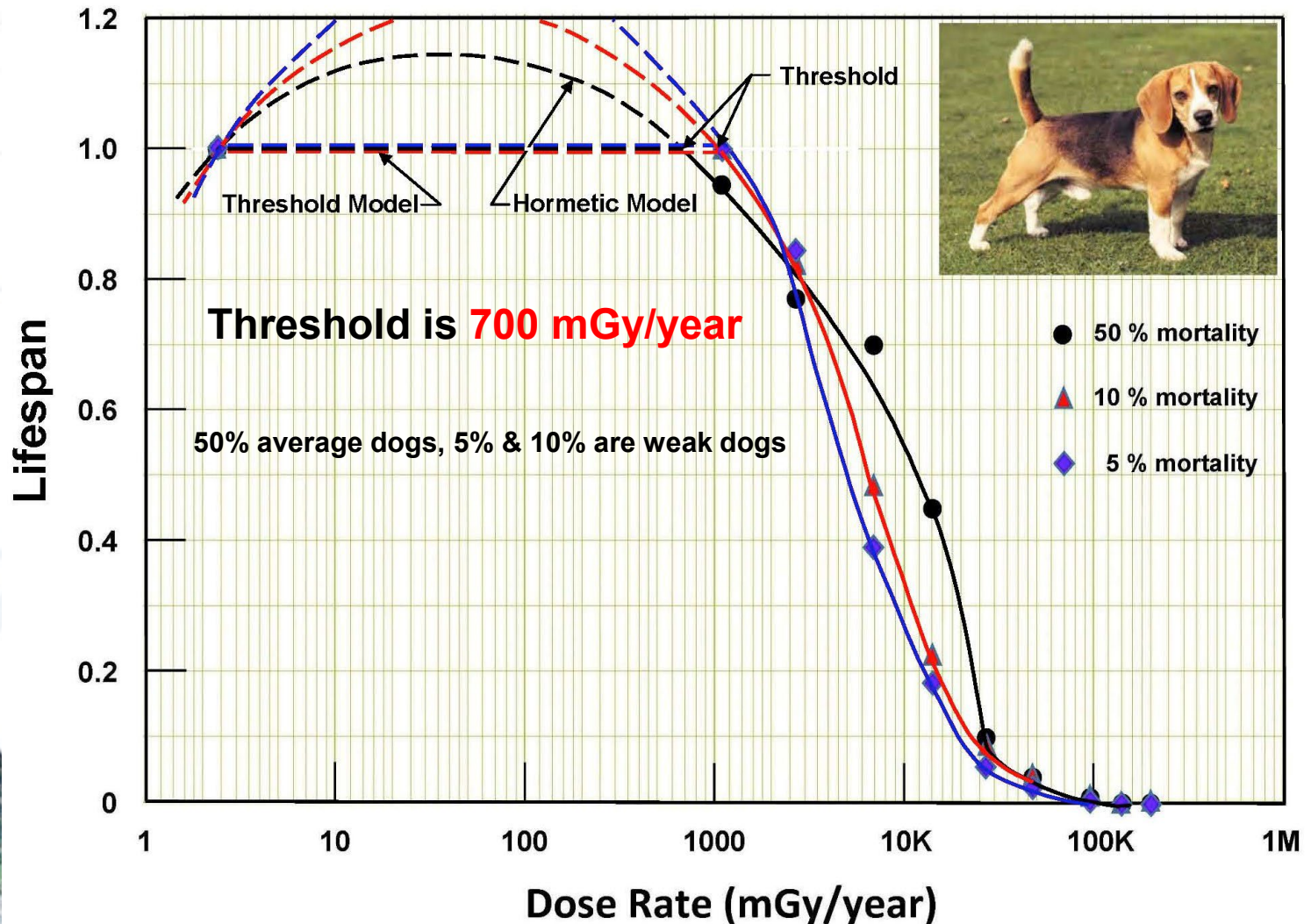
- Blood-forming stem cells in bone marrow are very radiation sensitive. Threshold for leukemia is 1.1 Gy.
- What about cancer in cells that are less radiation sensitive? Threshold dose should be **higher** than 1.1 Gy
- And latencies should be **longer** than 5 to 12 years
- Leukemia caused in **only** 48 cases in 10,051 survivors located in the high 3 to 6 Gy radiation zones, A and B
- Therefore, radiation is **not** a major cause of cancer

Organisms tolerate a high dose of radiation



Whicker. Environmental radiation and life
Health Phys. 2018; 114(2):192-203

Continuous cobalt-60 exposure affects life span



Why are all people afraid of radiation?

- Fear started after Japan 1945 atomic bombs, testing, and *arms race*. **Heat and blast** caused most deaths, not radiation
- President Eisenhower's Atoms for Peace Speech to UN in Dec 1953 proposed **nuclear energy** to make electricity, power ships, etc. that use oil, coal, natural gas. Rockefeller reacted.
- Rockefeller Foundation (funded by oil) directed U.S. National Academy of Sciences to recommend LNT hypothesis in **1956**
- In **1960**, U.S. National Committee on Radiation Protection led world to adopt "*precautionary principle*" policy and ALARA
- Caused much **fear**. 60 years scientific evidence was ignored
- United States and the whole world accepted these changes
- These changes link any radiation dose to risk of mutations and cancer. This is false information. It is wrong to accept it.

NAS-ATOM RAD

Dr. Brock

PY

THE ROCKEFELLER FOUNDATION
49 West 49th Street
New York 20, N. Y.

Rockefeller Foundation asked Eisenhower for permission to study genetic effects of radiation on organisms.

February 23, 1955

Dear Mr. President:

At the most recent meeting of the Board of Trustees of The Rockefeller Foundation there was an extended and sober discussion of a matter of deep concern to you and to all thoughtful men and women, namely, the effects of atomic radiation on living organisms.

Our Emergencies Measures organizations plan to distribute iodine: Mississauga to Port Hope



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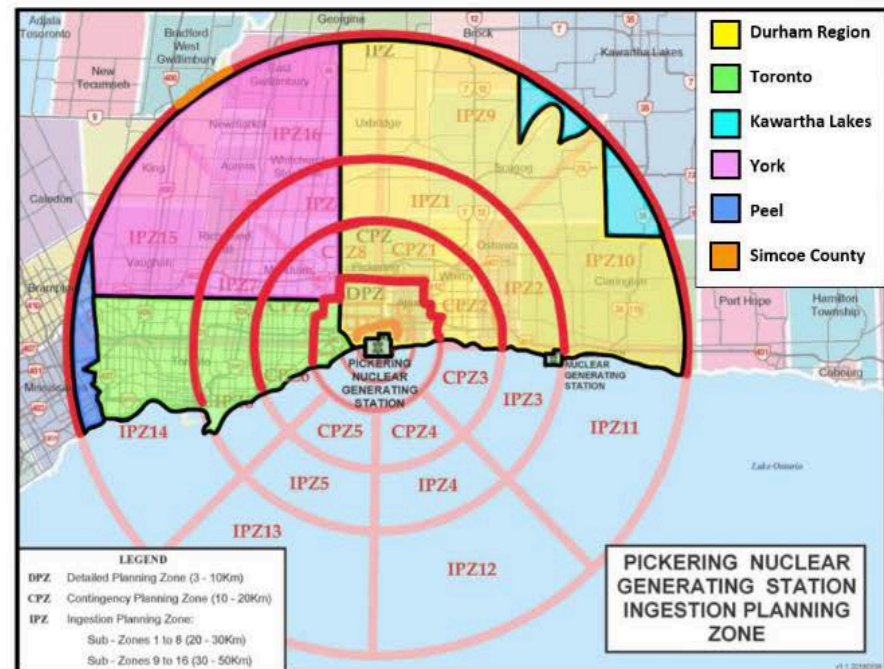
Canada



Commission Meeting, January 2022
CMD 22-M6.A

Ingestion Planning Zone

Ingestion Planning Zone (IPZ)
for Pickering Nuclear
Generating Station, and
associated municipalities



e-Doc 6696665 (PPT)
e-Doc 6720713 (PDF)

But radioiodine is not dangerous!

Study in Sweden 1988

Avg. thyroid dose 1.1 Gy

No evidence I-131 caused any cancers

Thyroid Cancer After Diagnostic Doses of Iodine-131: A Retrospective Cohort Study^{1,2}

Lars-Erik Holm,³ Kerstin E. Wiklund,³ Göran E. Lundell,³
N. Åke Bergman,⁴ Göran Bjelkengren,⁵ Ebbe S. Cederquist,⁶
Ulla-Britt C. Ericsson,⁵ Lars-Gunnar Larsson,⁴ Monika E. Lidberg,⁷
R. Sture Lindberg,⁸ Harriet V. Wicklund,⁹ John D. Boice, Jr.^{10,11}

The incidence of thyroid cancer was evaluated in 35,074 patients examined for suspected thyroid disorders between 1951 and 1969 with an average of 1.92 megabecquerel [(MBq) 52 μ Ci] of ¹³¹I. The radiation dose to the thyroid gland was, on the average, approximately 0.5 Gy. The mean age at the time of examination was 44 years; 5% were under age 20. Patients were followed for an average of 20 years. Record linkage with the Swedish Cancer Register identified 50 thyroid cancers occurring 5 years or more after the initial ¹³¹I examination, in contrast to 39.4 expected based on general population rates [standardized incidence ratio (SIR)=1.27, 95% confidence interval = 0.94–1.67]. Risk was highest among males (SIR = 2.70, n = 10), patients followed 5–9 years (SIR = 2.22, n = 23), and patients receiving more than 74 μ Ci or 2.74 MBq of ¹³¹I (SIR = 2.04, n = 17). However, these observations were confounded by the fact that patients examined for a suspected thyroid tumor received the highest ¹³¹I exposures and were at highest overall risk (SIR = 2.77, n = 34). Patients given ¹³¹I for reasons other than a suspected tumor were not at increased risk (SIR = 0.62, n = 16). Patients anticipated to be at highest risk, i.e., women (SIR = 1.12, n = 40) and those observed for 10 years or more (SIR = 0.93, n = 27), showed no evidence of a dose response. Overall, these data provide little proof that ¹³¹I is carcinogenic in humans and support the notion that the carcinogenic potential of internal ¹³¹I beta particles might be as low as four times less than external x rays or γ rays. [J Natl Cancer Inst 1988;80:1132–1138]

persed over large areas (1). Iodine-131 is still used extensively in nuclear medicine, and its potential carcinogenic properties are therefore a matter of concern to both scientists and the general public.

Animal experiments indicate that internal exposures to ¹³¹I beta particles are less carcinogenic than exposures to external photon radiation at high dose rates when compared rad by rad. The biological effectiveness of ¹³¹I compared to x-rays may be lower at high doses but similar at low doses and low dose rates (2). Iodine-131 also appears to be less effective in inducing thyroidal stochastic and nonstochastic damage than the short-lived radioiodines ¹³²I, ¹³³I, and ¹³⁵I, which

¹Received March 28, 1988; revised May 20, 1988; accepted June 1, 1988.

²Supported by Public Health Service contract CP-51034 from the National Cancer Institute, National Institutes of Health, Department of Health and Human Services; and by a grant from the National Institute of Radiation Protection, Stockholm, Sweden.

³Department of Cancer Prevention (L-E. Holm), Cancer Epidemiology Unit (K. E. Wiklund), and Department of General Oncology (G. E. Lundell), Radiumhemmet, Karolinska Hospital, S-104 01 Stockholm, Sweden.

⁴Department of General Oncology (N. A. Bergman) and Oncology Center (L-G. Larsson), University Hospital, S-901 85 Umeå, Sweden.

⁵Department of General Oncology (G. Bjelkengren) and Department of Diagnostic Nuclear Medicine (U-B. C. Ericsson), Malmö General Hospital, S-214 01 Malmö, Sweden.

⁶Department of General Oncology, University Hospital, S-221, 85 Lund, Sweden.

⁷Department of Hospital Physics, South Hospital, S-100 64 Stockholm, Sweden.

⁸Nuclear Medicine Section, Department of General Oncology, Sahlgren's

Study in England 1999

Avg. thyroid
dose 300 Gy

“Decrease in
overall cancer
is reassuring.”

Cancer incidence and mortality after radioiodine treatment for hyperthyroidism: a population-based cohort study

Jayne A Franklyn, Patrick Maisonneuve, Michael Sheppard, Joan Betteridge, Peter Boyle

Summary

Background Radioiodine is used increasingly as first-line treatment for hyperthyroidism, but concerns remain about subsequent risk of cancer, especially in those treated at a young age. We investigated cancer incidence and mortality in patients treated with radioiodine for hyperthyroidism.

Methods We did a population-based study in 7417 patients treated in Birmingham, UK, between 1950 and 1991. We compared details of all cancer diagnoses and deaths in 1971–91 from the UK Office for National Statistics with data on cancer incidence and mortality for England and Wales specific for age, sex, and period.

Findings During 72 073 person-years of follow-up, 334 cancer diagnoses were made, compared with an expected number of 761 (standardised incidence ratio [SIR] 0.83 [95% CI 0.77–0.90]). The relative risk of cancer mortality was also decreased (observed cancer deaths 448, expected 499; standardised mortality ratio [SMR] 0.90 [0.82–0.98]). Incidence of cancers of the pancreas, bronchus, trachea, bladder, and lymphatic and haemopoietic systems was lowered. Mortality from cancers at all these sites was also reduced but findings were significant only for bronchus and trachea. There were significant increases in incidence and mortality for cancers of the small bowel (SIR 4.81 [2.16–10.72], SMR 7.03 [3.16–15.66]) and thyroid (SIR 3.25 [1.69–6.25], SMR 2.78 [1.16–6.67]), although absolute risk of these cancers was small.

Interpretation The decrease in overall cancer incidence and mortality in those treated for hyperthyroidism with radioiodine is reassuring. The absolute risk of cancers of the small bowel and thyroid remain low, but the increased relative risk shows the need for long-term vigilance in those receiving radioiodine.

Introduction

Radioiodine is used increasingly as first-line therapy for hyperthyroidism.¹ Even though it has been used for this purpose for more than 50 years, concerns among patients and doctors remain about the subsequent risk of malignant disorders, especially among those treated at a young age.² These concerns have been heightened by reports of increased incidence of cancers after the Chernobyl nuclear accident, especially for thyroid cancer among children exposed at younger than 10 years to the main contaminating isotope iodine-131.^{3,4}

Although there have been several studies of cancer risk in patients treated with radioiodine for hyperthyroidism, results have been conflicting. Hall and colleagues⁵ studied the incidence of leukaemia in a large population of Swedish patients exposed to iodine-131 during diagnostic scanning or treatment of hyperthyroidism or thyroid cancer. No significant excess risk of leukaemia was seen, but the risk of stomach cancer increased with time and increasing dose of radioactivity.⁶ Other studies that compared cancer risk in those treated by surgery and with radioiodine for hyperthyroidism^{7–9} showed no difference in cancer incidence or mortality at these or other specific sites.

The small size of most studies and the low incidence of thyroid cancer has meant that an increase in thyroid-cancer incidence after radioiodine therapy has not been convincingly confirmed. By contrast, a small increase of thyroid-cancer deaths was reported in a Swedish cohort treated for hyperthyroidism,¹⁰ and an analysis of patients treated with radioiodine in centres throughout the USA in 1946–64 also reported an increase in thyroid-cancer mortality.¹¹

We investigated cancer incidence and mortality in patients treated with radioiodine for hyperthyroidism.

Patients and methods

UK study, lung cancer incidence down 40%

Site of cancer	Number of diagnoses		SIR (95% CI)	p	Number of deaths		SMR (95% CI)	p
	Observed	Expected			Observed	Expected		
Lip, oral cavity, and pharynx	5	9.0	0.55 (0.23-1.33)	0.19	2	5.4	0.37 (0.09-1.48)	0.16
Digestive organs and peritoneum								
Total	169	188	0.90 (0.77-1.04)	0.16	151	157	0.96 (0.82-1.12)	0.64
Stomach	38	39	0.97 (0.71-1.34)	0.86	39	37	1.05 (0.77-1.44)	0.76
Pancreas	11	23	0.47 (0.26-0.85)	0.01	17	24	0.72 (0.45-1.16)	0.18
Small bowel	6	1.2	4.81 (2.16-10.72)	0.0001	6	0.8	7.03 (3.16-15.66)	0.0001
Respiratory and intrathoracic organs								
Total	68	112	0.60 (0.48-0.77)	0.01	79	104	0.76 (0.61-0.95)	0.01
Bronchus and trachea	65	106	0.61 (0.48-0.78)	0.0001	78	100	0.78 (0.62-0.97)	0.03
Bone, connective tissue, skin, and breast								
Total	222	226	0.98 (0.86-1.12)	0.77	74	81	0.92 (0.73-1.15)	0.46
Breast	132	124	1.07 (0.90-1.27)	0.45	69	74	0.93 (0.74-1.18)	0.58
Genitourinary organs								
Total	97	128	0.76 (0.62-0.92)	0.006	62	78	0.80 (0.62-1.02)	0.07
Bladder	18	28	0.63 (0.40-1.00)	0.05	7	14	0.49 (0.23-1.03)	0.06
Other sites *								
Total	15	12	1.28 (0.77-2.13)	0.33	14	8.7	1.61 (0.89-2.55)	0.12
Brain	4	7.4	0.54 (0.20-1.44)	0.22	8	6.7	1.20 (0.60-2.40)	0.60
Thyroid	9	2.8	3.25 (1.69-6.25)	0.0004	5	1.8	2.78 (1.16-6.67)	0.02
Lymphatic and haemopoietic								
Total	24	39	0.61 (0.41-0.91)	0.02	25	30	0.84 (0.57-1.24)	0.38
Lymphoma	12	16	0.73 (0.41-1.28)	0.27	7	11	0.64 (0.31-1.34)	0.23
Leukaemia	10	13	0.75 (0.40-1.39)	0.36	13	11	1.17 (0.68-2.01)	0.58
All sites	634	761	0.83 (0.77-0.90)	0.0001	448	499	0.90 (0.82-0.98)	0.02

*International Classification of Diseases (ninth revision) codes 190-194, excluding 195-199 (secondary cancers).

Table 2: Cancer diagnoses and deaths

Thyroid is near windpipe and bronchial tubes

What about long-term health effects on the Chernobyl emergency workers?

Number of patients	Estimated dose (Gy)	Deaths during the first weeks
21	6 - 16	20
21	4 - 6	7
55	2 - 4	1
140	less than 2	0
Total 237		28

*** Used accurate biological dosimetry**

- Of the 237 who were hospitalized, 134 were heavily irradiated, 28 died, and **106 recovered** from doses* in range from 1 to 6 Gy.
- After 19 years, 22 of 106 had died; so, mortality rate 1.09%/year, which is **lower** than 1.4%/year for normal Russian workers
- After 30 years, the deaths increased to 26. So, the mortality rate was 0.82% per year---**lower still**
- Of 26 who died, **only 7 died of cancer**. This is the same as normal cancer mortality.

Distributing iodine pills is a cancer scare

- Emergency Measures follow the 'precautionary principle' policy. The iodine pills are to stop intake of radioiodine when a severe accident happens. **But I-131 does not cause cancer.**
- The pills cause residents to fear reactors because of cancer risk
- Canada should inform everyone that our reactors are safe, and that radioiodine does **not** cause cancer. No need for iodine pills.
- Canada should inform public about study on 35,074 patients in Sweden and the study on 7414 patients in England.
- **No increased** cancer from I-131; actually, saw decrease in cancer
- Thyroid screening at Chernobyl detected **natural**, self-limiting "occult thyroid cancer" nodules, which are harmless.

Conclusions #1

- Emergency Measures organizations, acting by the **'precautionary principle'** policy, ALARA. They are now planning to distribute iodine pills around Pickering NGS, from Mississauga to Port Hope.
- Iodine pills will start a cancer scare that will block initiatives to refurbish or replace Pickering NGS, after 50 years safe operation.
- Use of radiation in medicine has been beneficial for > 120 years. However, **Rockefeller Foundation created a radiation scare** from 1955-1960 to stop nuclear energy competing with oil-fired energy.
- A scare replaced safe dose threshold by linear no-threshold myth. False to say radiation dose increases risk of mutation and cancer.
- Fear is supported by **international consensus opinion** on radiation effects on health, which is contradicted by 120 years of science.

Conclusions #2

- It is wrong to distribute iodine pills; it causes false fear of cancer
- Canada should inform public about the study on 35,074 patients in Sweden and the study on 7,414 patients in England.
- Canada should inform everyone that our reactors are safe, and that radioiodine does **not** cause cancer. Therefore, distribution of iodine pills is **not** needed; it is harmful.