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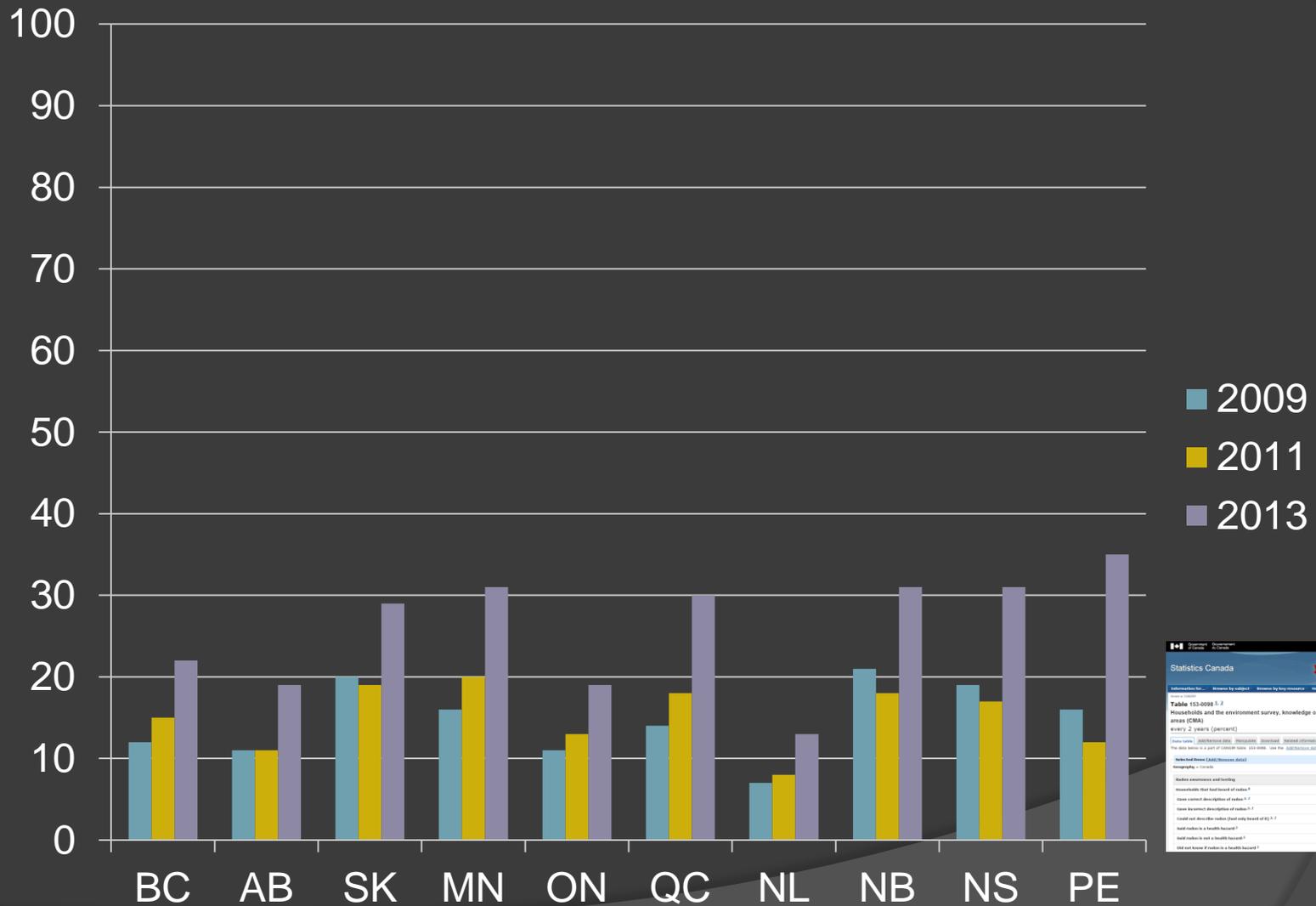
Surveillance of environmental & occupational  
exposures for cancer prevention

## From communication to mitigation: the challenges of managing radon exposure in Canada

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Simon Fraser University  
CAREX Canada  
NCCEH



# Statistic Canada: Households able to correctly describe radon gas (%)



Statistics Canada

Table 133-0009 1-3  
Households and the environment survey, knowledge of radon and testing, Canada, provinces and census metropolitan areas (CMA) every 2 years (percent)

2009 2011 2013

Knowledge of radon	2009	2011	2013
Households that had heard of radon?	62	67	68
Have correct description of radon? *	27	37	34
Have incorrect description of radon? *	24	24	24
Do not know description of radon? *	48	34	38
Do not know if radon is a health hazard? *	66	53	54
Do not know if radon is a health hazard? *	13	21	24
Do not know if radon is a health hazard? *	20	27	23



# Why so few people testing?

- ⊙ They aren't aware of the problem?

- This is accurate, HOWEVER....
  - 1989- Weinstein et al.

*“[New Jersey] Respondents proved well informed, but radon levels were not highly correlated with any of the response variables. **Over optimism was more common than overreaction.**”*

- ⊙ **Even when they know about radon, most didn't perceive it to be a risk**

# The Radon conundrum

“Interestingly, the **deep fears and anxieties associated with radiation do not seem to extend to naturally occurring radiation...**a survey in a region characterized by very high radon levels in many homes, found people who were **basically apathetic about the risk**  
-From Slovic 2012 (Sandman et al., 1987).”

Most people are afraid of radiation, **perhaps radon isn't understood as radioactive...**

# What else? History - Harrison and Hoberg 1991

- Canadian lack of awareness (1991!) due to government's historical approach to managing radon
- Government chose not to publicize 1977 survey of 14,000 homes
  - Didn't encourage testing till much later
- Dr Roger Eaton (Health and Welfare Canada) high profile quotes-
  - “As we say, you can't tame nature: you just have to live with it”
  - “...until everybody stops smoking, there not much point in spending money...on techniques to reduce radon in homes

# Canada vs. US

- Canadian officials initially felt US EPA had overestimated risk
  - Decided not to elevate radon issue across Canada
  - “Not worth disturbing the public given that the risk is such a small one” Health and Welfare statement

## Radon tests on houses rejected

Staff

*The Globe and Mail (1936-Current)*; Sep 14, 1988;

ProQuest Historical Newspapers: The Globe and Mail (1844-20  
pg. A11

## Radon tests on houses rejected

Staff, Canadian Press  
and Associated Press

Canada is not following the lead of the U.S. Environmental Protection Agency, which urged Monday that all houses be tested for radon gas, a colorless, odorless gas linked to lung cancer.

New U.S. surveys show particularly high levels of the gas in Minnesota, North Dakota and Pennsylvania, EPA administrator Lee Thomas said.

The average house in those states contains radon above the EPA's guidelines, according to figures released Monday at a joint news conference of the environmental agency and the U.S. Public Health Service in Washington.

# Where are we now?

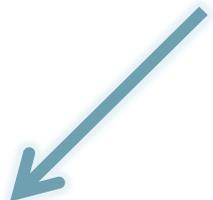
- We need to increase both *knowledge of* and *concern about* radon

**ra·don**

*/ˈrā,dän/* 

*noun*

the chemical element of atomic number 86, a rare radioactive gas belonging to the noble gas series.



- We still need to get people to test their homes and mitigate if necessary

# Rethinking radon communication

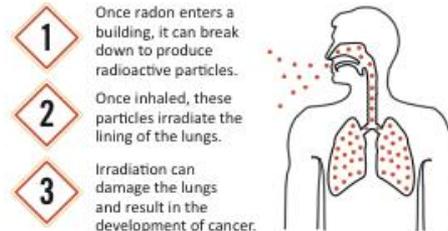
Re-introducing radioactivity  
It's a "radioactive gas"

Public Health Ontario  
PARTNERS FOR HEALTH

Santé publique Ontario  
PARTENAIRES POUR LA SANTÉ

## RADON AND THE LUNGS

Radon is invisible and odourless,<sup>1</sup> and radon can kill.<sup>2</sup>



## LOWER LEVELS ARE BETTER

Any exposure to radon poses some risk to Ontarians.<sup>3</sup> However, there are benefits to reducing exposure to as low as possible.

200 Bq/m<sup>3</sup>

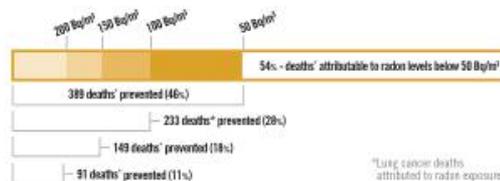
Health Canada recommends action be taken above this level.<sup>4,5</sup>



The estimated percentage of Ontarians who lived in homes with radon concentrations greater than 200 Bq/m<sup>3</sup> in 2009-2011.<sup>4</sup>

Becquerel (Bq) = The unit used to measure the number of radioactive decays of a radon atom

Radon-attributable lung cancer deaths that could be prevented each year if all homes above these levels were at background level (10-30 Bq/m<sup>3</sup>), Ontario, 2007<sup>3</sup>

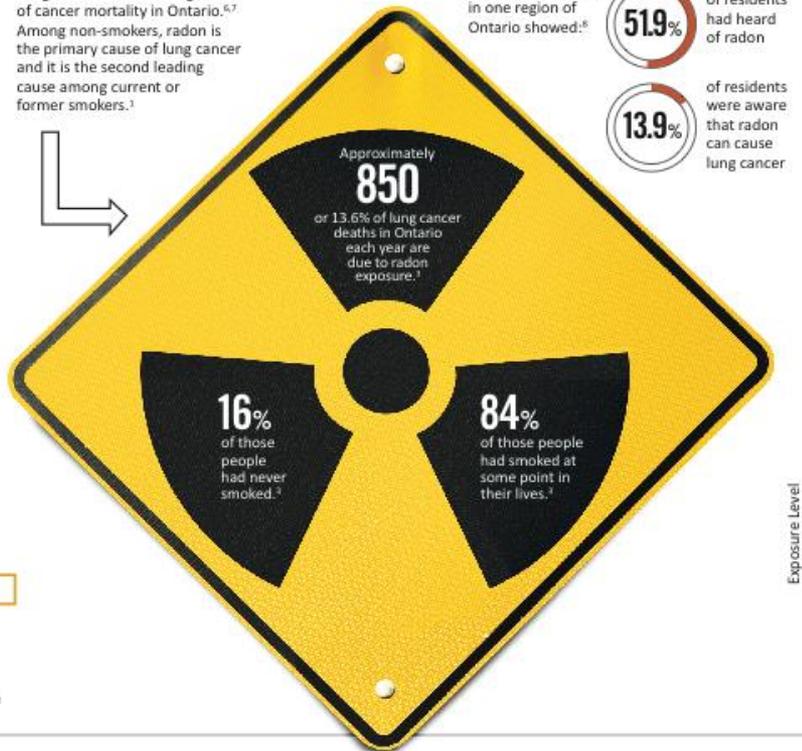
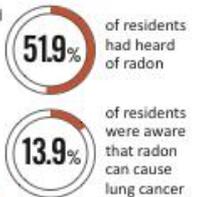


# RADON RISKS AND REALITIES

Radon is a naturally occurring radioactive gas found in soil, water and outdoor air, and can enter buildings and accumulate in indoor air.<sup>1</sup> Classified as a carcinogen by the International Agency for Research on Cancer, radon is one of the leading causes of lung cancer.<sup>2</sup> Reducing exposure to indoor radon would result in fewer lung cancers in Ontario.

Lung cancer is the leading cause of cancer mortality in Ontario.<sup>5,7</sup> Among non-smokers, radon is the primary cause of lung cancer and it is the second leading cause among current or former smokers.<sup>1</sup>

A survey conducted in one region of Ontario showed:<sup>6</sup>



# Re-thinking naturally occurring?

- Winnie Cheung et al 2013, Bill Angel, and others- human-made problem

[Display Settings:](#)  Abstract

[Send to:](#)

[Sci Total Environ.](#) 1985 Oct;45:271-8.

## **Radon and radon daughter levels in energy efficient housing.**

[McGregor RG](#), [Walker WB](#), [Létourneau EG](#).

### **Abstract**

Radon and radon daughter concentrations have been measured in 33 "energy-efficient" homes in a small subdivision in Kanata, Ontario. Integrated radon measurements were determined over three month periods for a year using solid state nuclear track detectors. Radon and radon daughter grab sample determinations were made during corresponding periods and confirm the distributions of the integrated radon measurements. Annual average individual home radon concentrations show an 8 fold concentration range between homes. This variability in radon concentrations is not reflected in the range of air exchange rates for the homes. A distinct seasonal variation is noted for the median values of the radon and radon daughter concentrations and the equilibrium factor F in the dwellings.

PMID: 4081725 [PubMed - indexed for MEDLINE]

- REFRAME issue to be building-oriented
  - The housing design makes radon a risk

# Other strategies being tried

- Make it noticeable:
  - Radon alarm- goes off at a certain level
    - Similar to concept of CO detector
    - Makes what is invisible at least audible

Cloud Chamber-  
Health Canada



# Increasing agency involvement

- ① Health Canada has developed a substantive radon platform
  - Not all provinces have followed suit
    - E.g. National building code
- ① **Problem too large for one agency**
  - Provincial and municipal governments need to get involved
  - Better citizen based groups
    - Starting in some parts of the country
- ① Canadian Association for Radon Scientists and Technicians created (CARST)

# Better Media coverage

- ⦿ The media shapes how the general public views risks
- ⦿ How has media coverage of radon functioned in Canada?
  - Begun small study at SFU
- ⦿ Initial radon coverage discussed the problem as “radioactive”
- ⦿ 1990s show a period of “questioning” science
- ⦿ Coverage tapers off late 1990s, early 2000s
  - Other things pushed radon off the agenda

# Radiation found in wells near Kingston

By KIRK MAKIN

Well-water surveys in a small township near Kingston, Ont., have turned up high concentrations of radioactive gases, radium and uranium.

The substances, discovered in well water in Front of Escott Township, occur naturally in uranium-bearing rock found in the three adjoining counties of Leeds, Grenville and Lanark.

Dr. John Hodgkinson, medical officer of health for the three counties, said it is "highly unlikely" that water testing will be limited to the township and a five-year water study of all three counties may be started after Front of Escott's immediate problem is dealt with.

Such a study would probably also trace health records to determine if there has been an increased incidence

of disease, Dr. Hodgkinson said.

Radium concentrations up to seven times the provincial limit have been found in a study of Front of Escott wells by a Queen's University team.

The team found radon gas concentrations up to about 22,000 picocuries per litre — well above the loose provincial guideline for further study of 10,000 picocuries. An Ontario Ministry of Health test gave a reading of 18,000 picocuries from the well cited at 22,000 in the Queen's study.

About one-tenth of Front of Escott's 650 wells have been tested, most of those by the Health Ministry, and measurements in most fell below the 10,000-picocurie guideline.

Dr. Hodgkinson said the wells probably will be retested because people may have disguised the true radon count by ventilating their homes dur-

ing the tests.

Front of Escott residents and councillors are concerned about the possible effects of the radiation on their health — and on land values.

Radon gas is produced during the decay of radium. Radon daughters — the short-lived offspring of radon — can cause lung cancer, while radium poses a risk of cancer of the bones and blood.

"I think we're hurting ourselves when we publicize this," said Wayne Thompson, deputy reeve of the township. "I'm sure that anyone thinking of buying along the (St. Lawrence) River would think twice now."

The township has resisted Ontario Government involvement in testing its water. It recently sent a letter to the Health Ministry saying the public doesn't trust any level of government

to do the studies, Dr. Hodgkinson said.

There also was concern that radon in water samples might dissipate before it reached Toronto for testing.

Mr. Thompson said he is resigned to the Government's role in the testing, "but others still want Queen's to do it."

Dr. Hodgkinson said the Government is capable of doing reliable testing. "I don't buy their (the councillors') arguments at all," he said. "I've had no complaints from any citizens yet."

One resident who said readings for radium and uranium in his water were well over the guidelines said, "People here are afraid the Government will end up saying, 'Oh, the levels are acceptable.' If they are, then why have they advised us not to drink the water?"

The man, who requested anonymously, said he now goes for water at nearby Rockport.

"So far there is a pattern of no pattern," Dr. Hodgkinson said. Readings have fluctuated from well to well and at varying depths. "Plotted on a graph, it looks like an ECG (electrocardiogram) machine gone crazy."

Jacques Nantel, head of the Queen's University team which did the initial well-testing, has applied for a grant to do an independent water study.

He said safety levels various governments have set for radium in water may be a partial explanation of the public skepticism.

The provincial limit is three picocuries per cubic centimetre, while the federal Government uses 27 picocuries as a limit and the Atomic Energy Control Board has a limit of seven.

"It's definitely nothing to inspire confidence," he said.

The discovery focuses attention on the potential dangers of radiation that man is not responsible for, Dr. Nantel said.

"Sometimes we all want somebody to blame. But we're at a loss on this one — we have to deal with God."

There are other areas in North America where natural radiation levels are high, he said. One is Elliot Lake, in Northern Ontario, where some homes are specially ventilated to stop the buildup of airborne radon gas.

Dr. Nantel said water-borne radon can be reduced by agitation, but radium is much more difficult to remove.

Studies at Queen's show that most radon is eliminated from the main water supplies of Brockville and Kingston before it flows from the tap — probably because of agitation during the filtration process. He had no knowledge of any tests for radium in those cities.

Globe and Mail,  
January, 1981  
Radioactivity  
highlighted

# Fostering Doubt in the mid 1990s

## Taking the risk out of radon

MICHEL SMITH SPECIAL TO THE GLOBE AND MAIL

*The Globe and Mail* (1936-Current); Apr 16, 1994;

ProQuest Historical Newspapers: The Globe and Mail (1844-2011)

pg. D8

### RADIATION

# Taking the risk out of radon

BY MICHAEL SMITH  
SPECIAL TO THE GLOBE AND MAIL  
TORONTO

**T**WENTY years have passed since North America got its first big scare about radon, the odourless, colourless, radioactive gas that seeps into houses from concrete, bricks and soils, and may inflict grave illness on householders.

Now, a Canadian research project has concluded there is no detectable cancer risk from household radon. Indeed, there's even a suggestion that the small doses found in homes may increase resistance to cancer. The 10-year analysis, to be published later this year, is the most ex-

A CANADIAN STUDY CONCLUDES THAT THE GAS DOESN'T SNEAK THROUGH THE WALLS OF YOUR HOUSE AND CAUSE CANCER. YET AFTER ALL THESE YEARS, THE DOUBTS REMAIN



the study — actually had a slightly greater cumulative exposure to radon than did the cancer victims. "It can't be explained, but it's a finding that has shown up in a number of ... studies."

Those studies, by biophysicist Bernard Cohen of the University of Pittsburgh, seem to indicate that places in the United States where there's relatively high household radon experience lower rates of lung cancer. Dr. Cohen analyzed about 1,700 U.S. counties, containing nearly 90 per cent of the U.S. population. He compared average rates of household radon with average rates of lung cancer — a rough-and-ready measure, he admits.

The result, after controlling for obvious things like cigarette smok-



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## Yukoners urged to test homes for radon

Radioactive gas a leading cause of lung cancer among Canadians

CBC News Posted: Nov 16, 2015 2:17 PM CT | Last Updated: Nov 17, 2015 1:22 PM CT



'You can't really tell if it's in your house until you test,' said Erik Simanis, one of 7 newly-trained radon mitigation specialists in Whitehorse. (CBC)

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Yukon health officials and housing authorities are warning people about the dangers of radon gas and urging them to protect themselves.

Tests done over the past 20 years show the concentration of radon in Yukon homes is among the highest in Canada. Of a thousand Yukon homes that have been tested, at least 30 per cent exceeded Health Canada safety standards.

Almost 10 per cent have shown dangerously high levels of the radioactive gas.

"It causes cancer," says Catherine Elliott, Yukon's deputy medical officer of health. "I think we've known for a long time that radioactivity causes cancer in tissues, and radon is a radioactive gas that you breath into



'Radon is for real,' said Yukon's deputy medical officer of health, Catherine Elliott. 'It causes cancer.' (CBC)

### Related Stories

- Radon gas suspected in Prince George, B.C., family tragedy
- Yukon inventor wins \$60K for radon system

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### LATEST STORY



## Everyone needs to check for cancer-causing radon gas in the home: former astronaut

Dr. Roberta Bondar, the first Canadian woman in space, is warning Canadians about the dangers of radon gas in homes and its very serious links to lung cancer.

Smell of pot smoke at centre of Yukon Human Rights Commission complaint

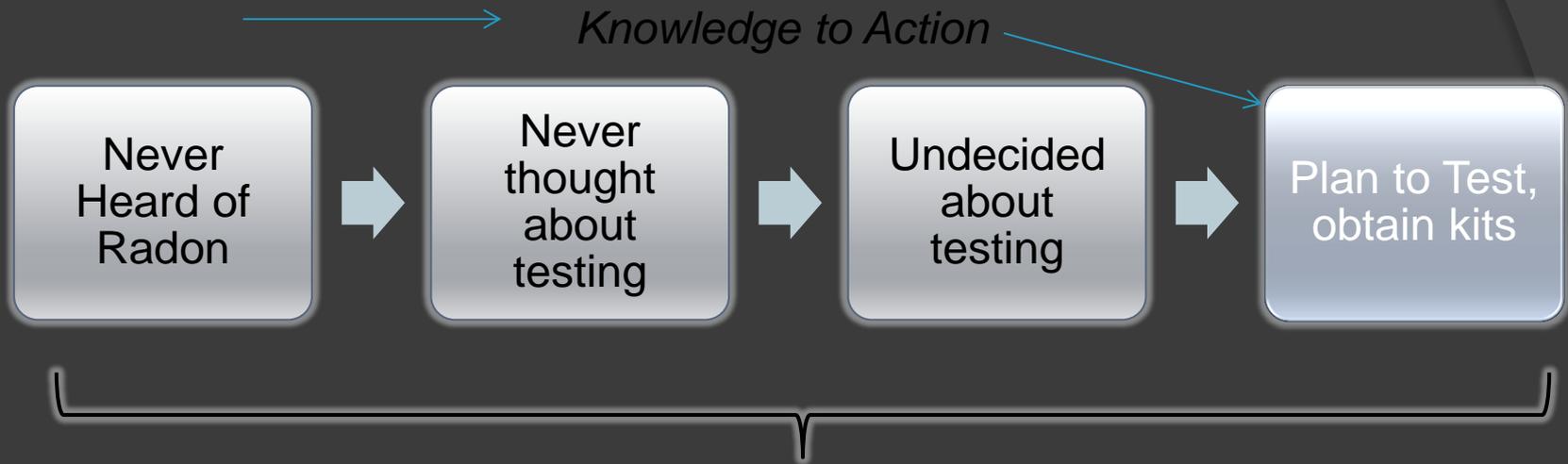
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# How to get people galvanized?

- ◉ Reframing of messages
- ◉ Governments and NGO leadership
- ◉ Improve media coverage
  - Maybe radiation professions can help journalists reclaim the issue
- ◉ **BUT- we need CHANGE not just awareness**
- ◉ Precaution Adoption Process:
  - Weinstein and Sandman (1992)
  - Research done in the US during the 1980s
  - 2 phases

# Radon Framework: First Phase



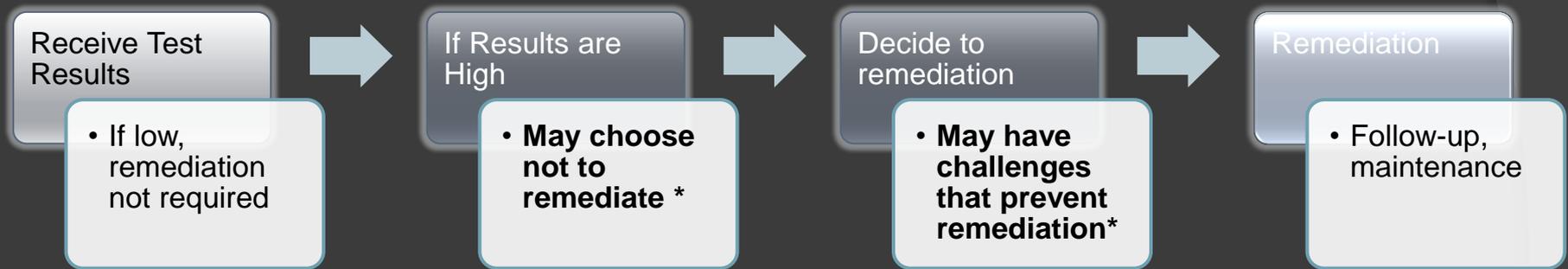
Key Features of this Phase:

**Raising Awareness**  
**Encouraging Testing**  
**Providing access to test kits**

Tools needed: informational resources, **persuasive campaigns**,  
**targeted outreach in high radon regions**

# Radon Framework Phase 2

→ *Knowledge to Action* →



Key Features of this Phase:

- Helping citizens interpret test results
- Recognizing people's rights to NOT remediate
- is more persuasion key at this point?**
- Decisions to remediate can be hampered, e.g. \$,

time

More help needed on these fronts

# Precaution Adoption Process: Weinstein and Sandman (1992)

- ⦿ Factors associated with testing and remediate
- ⦿ Other People's Behaviour (peer influence high)

“If the Jones's tested, maybe I should...”

# What gets people to test for radon?

Nissen et al 2011

Variable	response
Concern for health	47%
Concern for children's health	17.6%
Realtor recommended it	19.6%
Free/cheap test kit	17.6%
Concerned about property value	7.6%
Doctor recommended it	3%
<b>Predictive Model Variable</b>	
Higher Education	
Higher Income	
Non or ex-smokers	

This intervention research found that of those with higher than regulatory levels, less than half were going to remediate

**Cost** was the main factor cited for **not** remediating

# In conclusion

- ⦿ Majority of Canadian aren't aware of radon
- ⦿ Work on messaging
  - **Radon: the worse thing you never heard of"**
  - **"Radioactive gas"**
- ⦿ We need to work together
  - Multiple agencies and communities
- ⦿ We need to **help people move through the process**
  - Giving out test kits isn't enough
  - Support for remediation
  - **Reducing exposure is key**

ED WAS A  
REGULAR GUY.



ED WORRIED ABOUT  
THE GREENHOUSE  
EFFECT. ABOUT THE  
OZONE LAYER.



AND ABOUT FOULED  
BEACHES. AND  
PESTICIDES IN FOOD.



THE WORLD WAS TOO  
DANGEROUS, ED DECIDED.



SO HE NEVER WENT  
OUT AGAIN. ED STAYED  
IN HIS HOME.



AND THE RADON  
GOT HIM.



Thank you! [anicol@sfu.ca](mailto:anicol@sfu.ca)

# Mitigation in Vermont homes given test kits- Reisenfeld 2007

- ◎ Of homes with high levels, 43% mitigated
  - 67% of work done by contractor
  - Avg. cost \$ 1000-2000
- ◎ Significant remediation predictors
  - College education or higher
  - Concern about property values
  - People who lived in a newer home
- ◎ Factors NOT significant
  - Age, gender, household income, number of people in the home and living in the basement, radon level

“Associating radon testing with real estate transactions is likely to influence residents to mitigate as home value appears to be a significant concern.”

# UK research on remediation

- ◎ Survey of homes  $>195\text{Bq/L}$  Zhang et al 2011
  - Response rate 49%
- ◎ 30% reported some form of remediation
  - Most within 6 months of testing
    - Sump with fan
    - Fan assistant under-floor ventilation
    - Natural underfloor ventilation with air brocks
    - Indoor ventilation with positive pressure
  - 52% of people spent  $<500$  £, 3% spent  $>3000$  £

# Irish remediation study

- ◎ 3,313 homes over 200 bq/m<sup>3</sup>
  - 1058 (33%) response rate
- ◎ 24% had carried out some form of remediation, 32% retested
  - Sealing floors and walls
  - Indoor ventilation
  - Under floor ventilation
  - Positive pressurisation
  - Average cost 1,650 €
  - 64% reduction in radon levels