

Health risk related to environmental and clinical radon sources: necessity to increase public awareness

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PRESENTATION OUTLINE

- ❖ Introduction – lung cancer
- ❖ What is radon
- ❖ Correlation of radon with cancer induction
- ❖ Radon-related health risk – acceptable limits
- ❖ Medical practices and radon
- ❖ Radon concentration measurement – mitigation
- ❖ Results

INTRODUCTION – LUNG CANCER (1/2)

- ❖ High levels of incidence and mortality both in men and women
- ❖ 5-year survival: ~25% (study-dependent)
- ❖ When diagnosed, in 79% of the cases it is not localized
 - ~22%: lymph nodes are affected
 - ~57%: metastases

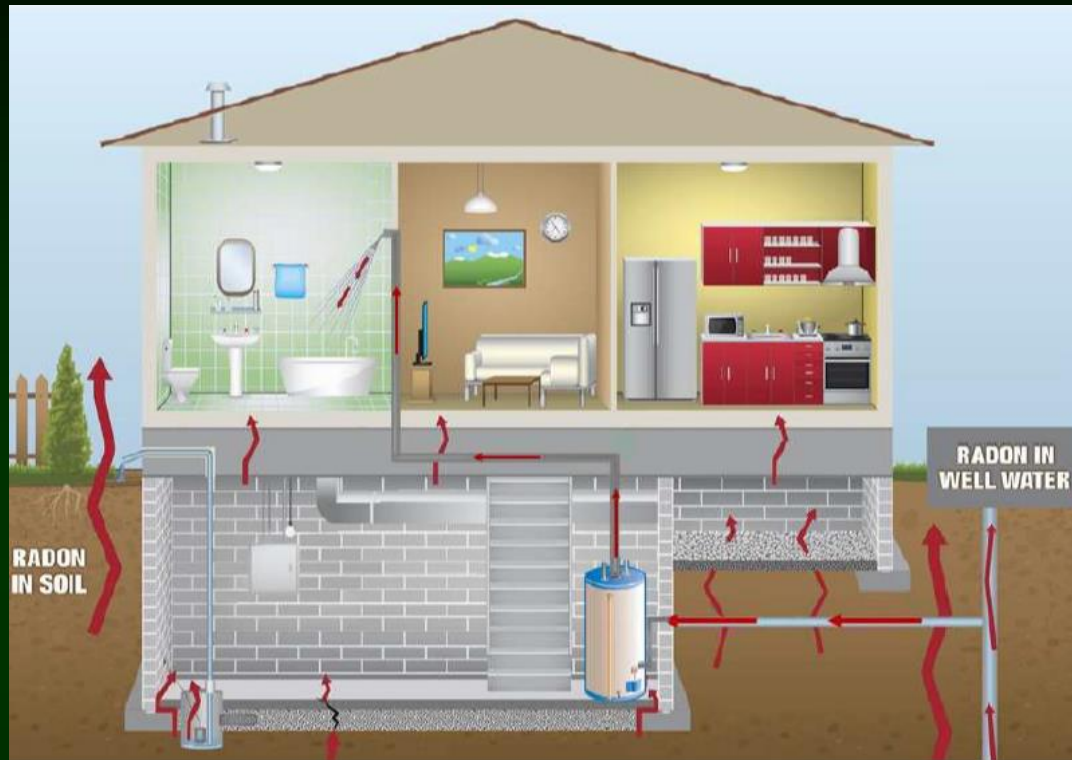
INTRODUCTION – LUNG CANCER (2/2)

- ❖ ~80% deaths due to lung cancer: smokers
- ❖ Mortality due to lung cancer also exists in NON-smokers
- ❖ Most important environmental risk factor for lung cancer development for the whole population, also being no. 1 risk for non-smokers : **RADON**

WHAT IS RADON (1/2)

- ❖ Radioactive gas
- ❖ Exists in nature (uranium – radium– radon – polonium)
- ❖ Invisible – odorless – tasteless – not perceivable with human senses

WHAT IS RADON (2/2)



- ❖ ↑ concentration inside buildings – basements/ground floors
- ❖ Ground permeability – cracks – pipes – well water
- ❖ 2ⁿ most important cause of lung cancer

CORRELATION OF RADON WITH CANCER

- ❖ 1770: Carl Lebrecht Scheffler
 - Studied health of mine workers
 - Radon is found out to be responsible for cancer induction

- ❖ 1988: IARC (International Agency for Research on Cancer)
 - Radon is listed as a known carcinogenesis agent

HOW RADON EXPOSURE INDUCES CANCER

- ❖ Po-214, Po-218
 - Products of radon radioactive decay
 - α - emitters of high LET
- ❖ Responsible for radiation burden of lungs during inhalation
- ❖ Single- and Double- strand breaks of DNA

CORRELATION OF RADON EXPOSURE AND CARCINOGENESIS: PROOF (1/2)

❖ Laboratory studies

- DNA strand breaks due to Po-214, Po-218

❖ Test animals

- Radon exposure induces lung cancer

❖ Retrospective epidemiological studies – mine workers

- Last 50 years: 15 large-scale epidemiological studies (USA – Canada – Australia – China – Europe)
- 68.000 workers
- Latent period: 5 years
- BEIR Committee: workers' deaths: 39% (smokers) – 73% (non-smokers) are attributed to radon

CORRELATION OF RADON EXPOSURE AND CARCINOGENESIS: PROOF (2/2)

❖ Case-control epidemiological studies

- 22 large-scale studies
- **↑** radon concentration by **100 Bq/m³** **→**
excess relative risk of lung cancer development
 - **+11%** (USA-Canada studies)
 - **+16%** (European studies)
 - **+33%** (China studies)

RADON EXPOSURE ASSOCIATED RISK DATA

(1/3)

- ❖ 8th highest cause of mortality in USA (EPA)
- ❖ No. 1 environmental risk factor for lung cancer development in USA

| CAUSE OF DEATH | ANNUAL MORTALITY ASSESSMENT IN USA (2018) |
|---|--|
| 1st. Lung cancer | 154000 |
| 4th. Breast cancer | 41000 |
| 6th. Prostate cancer | 29000 |
| 8th. Non-Hodgkin lymphoma | 21000 |
| RADON | 21000 |
| 12th. Ovaries' cancer | 14000 |

RADON EXPOSURE ASSOCIATED RISK DATA (2/3)

- ❖ ~21000 deaths due to radon exposure in USA annually

| CITY IN GREECE | POPULATION (inhabitants) |
|-----------------------|---------------------------------|
| Sparta | 19000 |
| Preveza | 19000 |
| Livadia | 21000 |
| Arta | 22000 |

- ❖ The population of a whole city of such size dies due to radon exposure in USA annually

RADON EXPOSURE ASSOCIATED RISK DATA

RISK OF LUNG CANCER INDUCTION DUE TO RADON EXPOSURE (RESIDENCES)

| Rn conc.(pCi/l) | Rn conc.(Bq/m³) | Health risk – non smokers (%) * | Health risk –smokers (%) |
|----------------------------|---------------------------------------|--|-------------------------------------|
| 1.25 | 46 | 0.2 | 2.0 |
| 2 | 74 | 0.4 | 3.2 |
| 4 | 148 | 0.7 | 6.2 |
| 10 | 370 | 1.8 | 15.0 |

- ❖ * non-smokers: max 100 cigarettes during lifetime
- ❖ Synergy of smoking – radon factors

ACCEPTABLE LIMITS OF RADON CONCENTRATION - RESIDENCES (ARE THEY SAFETY LIMITS?)

- ❖ Acceptable limits: NOT safety limits
- ❖ They correspond to a level of risk that is considered to be acceptable

| BODY | ACCEPTABLE LIMIT (Bq/m³) | ACCEPTABLE LIMIT (pCi/l) |
|-------------|--|-------------------------------------|
| WHO | 100 | 2.7 |
| EPA | 148 | 4 |

ARE THERE ANY MEDICAL PRACTICES CURRENTLY AVAILABLE THAT MAY RESULT IN INCREASED RADON CONCENTRATION LEVELS?

- ❖ Ra-223: bone metastases due to prostate cancer
- ❖ Slow administration – the patient exhales radon
- ❖ Radon concentration around the patient: ~2 MBq/m³
(~10000 times or 4 orders of magnitude above the acceptable limits of radon concentration in residences)

RADON CONCENTRATION MEASUREMENT

❖ Who - how

- Special equipment/experts (bodies or companies)

❖ When

- EPA: recommends measurement of radon concentration in residences every 5 years (with cooling-heating systems on and off) or after extended building renovation or cooling-heating systems changes

❖ Acceptable limits

- EPA: 4 pCi/l (148 Bq/m³) - safe side 2 pCi/l (74 Bq/m³)
- USA: inside residences 48 Bq/m³ – outside 15 Bq/m³

❖ Aim

- Radon concentration inside = Radon concentration outside (in all cases <2 pCi/l = 74 Bq/m³)

RADON MITIGATION MEASURES

- ❖ Provision during construction (reduced cost)
- ❖ In case of older buildings: intervention (Active Soil Depressurization System)
- ❖ USA: recommendation for screening in sensitive target groups with LDCT (e.g. annually for smokers 50 y.o., 1 package of cigarettes/day during the last 20 years, **recorded living in a high radon concentration residence**)

IN CONCLUSION...

- ❖ Radon issue should be studied in depth by health professionals – public awareness needs to be increased
- ❖ **PROVISION** in residences under construction (amendment of radon-related guidelines during upgrading of national building code legislation)
- ❖ **MEASUREMENT AND MITIGATION** in case of older establishments (residences – educational institutes – workplaces)
- ❖ **SCREENING**

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Thank you for your time...

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