Updating the ICRP's Recommendations - A Practitioners Perspective

Presented to:

ICRP's Digital Workshop on the Future of Radiological Protection

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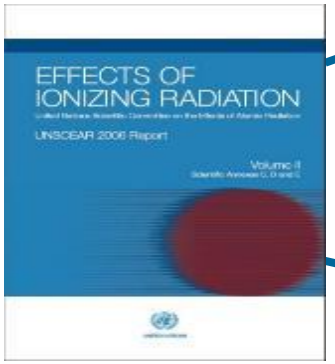
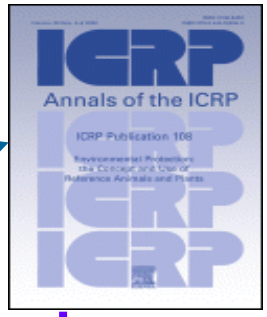
The International Radiation Safety Regime

is key to maintaining the credibility of radiation risk estimates and the future development of new applications of radionuclides and peaceful applications of nuclear energy



UNSCEAR
Scientific basis

issues
effects
risks



ICRP
Protection philosophy,
principles and units

recommendations

issues
levels
trends

IAEA, WHO, ILO, FAO etc.
- Safety standards
- Protection programmes

implemented by
Member States

ILO convention 115:
occupational
radiation protection

FAO/WHO
Codex Alimentarius Commission
(food contamination guides)

UN transport regulations for
radioactive material

Canada's SMR Action Plan (2019)

Has the vision of

Small Modular Reactors as a source of safe, clean,affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians

For this vision to be achieved, the public and indigenous communities must be comfortable that the technology is safe, and the risks are "*socially acceptable*"

Who Does the Public Trust?

A recent survey of public opinion in Saskatchewan and Ontario observed that

- Scientists are the most trusted source of information and elected officials the least trusted
- Regulators (in Canada, the CNSC) were the second most trusted source of information
- Scientists contribute to the work of UNSCEAR and the ICRP and ICRP's recommendations provide the basis for radiation protection guidance world-wide
- The recommendations of the ICRP need to be scientifically sound but they must also be able to be understood to some level by members of the public

ALARA-1

- The principle of optimization of protection and safety states that

  'the likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors' (ICRP, 2007)

- The ICRP acknowledges that optimization of protection and safety

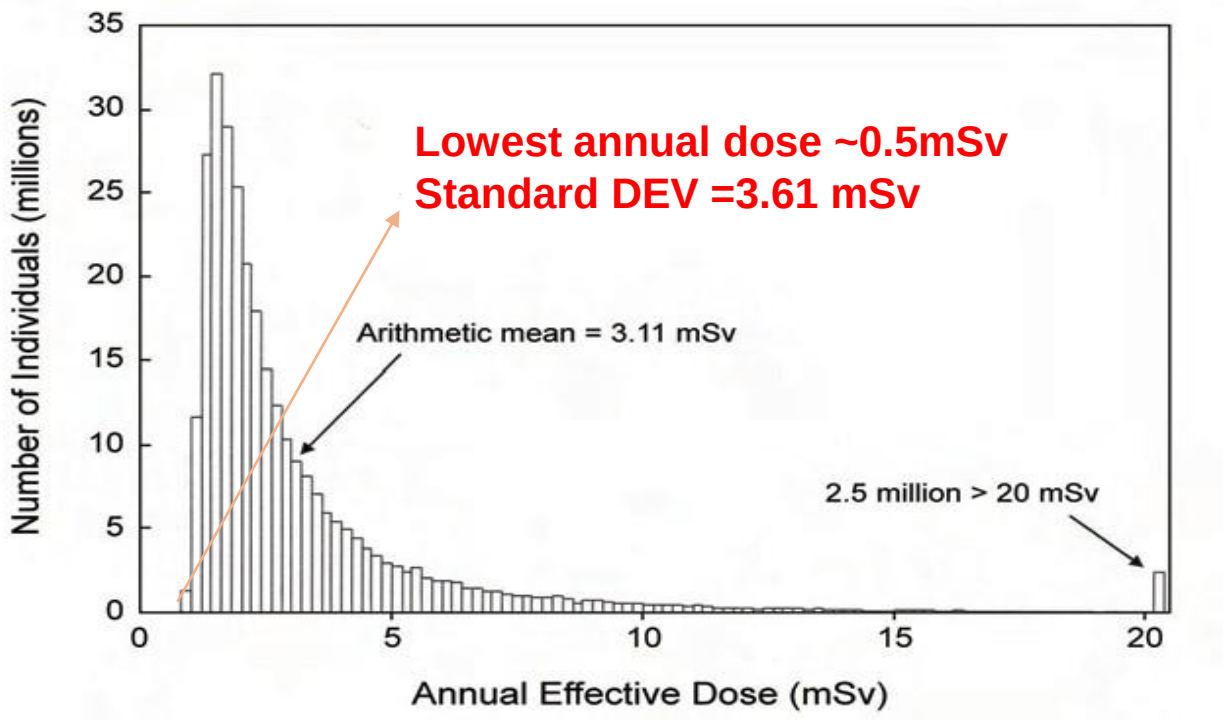
  should not consistently seek the lowest exposures or risks possible, but a balance of factors including dose, risk, and other considerations

- However, in practice this can be and is often interpreted that every effort should be made to drive the dose to individual to as low as possible and "be damned the expense"

  We support the ICRP's proposed work of Task Group 114 to clarify the "reasonable" implementation of ALARA

ALARA-2

Distribution of Natural Background Dose (after NCRP 160)



ALARA -3

We respectfully suggest that a dose cut-off be considered for use in ALARA assessments. This can be quite controversial but is a discussion worth having

- Such a cutoff could be a dose or a risk; however, when the dose is low, the risk is low (irrespective of dose response)
- UNSCEAR 2008 Annex B Table 12 suggests that the annual effective dose to an individual member of the public from natural radiation is about 2.4 mSv with a range of from 1-13 mSv.
- From the authors perspective, a dose cutoff of perhaps
  - for a worker, a dose cut-off of perhaps 1 mSv seems reasonable,
  - for a member of the public a dose cut-off of 0.1 (to 0.3?) mSv seems reasonable.

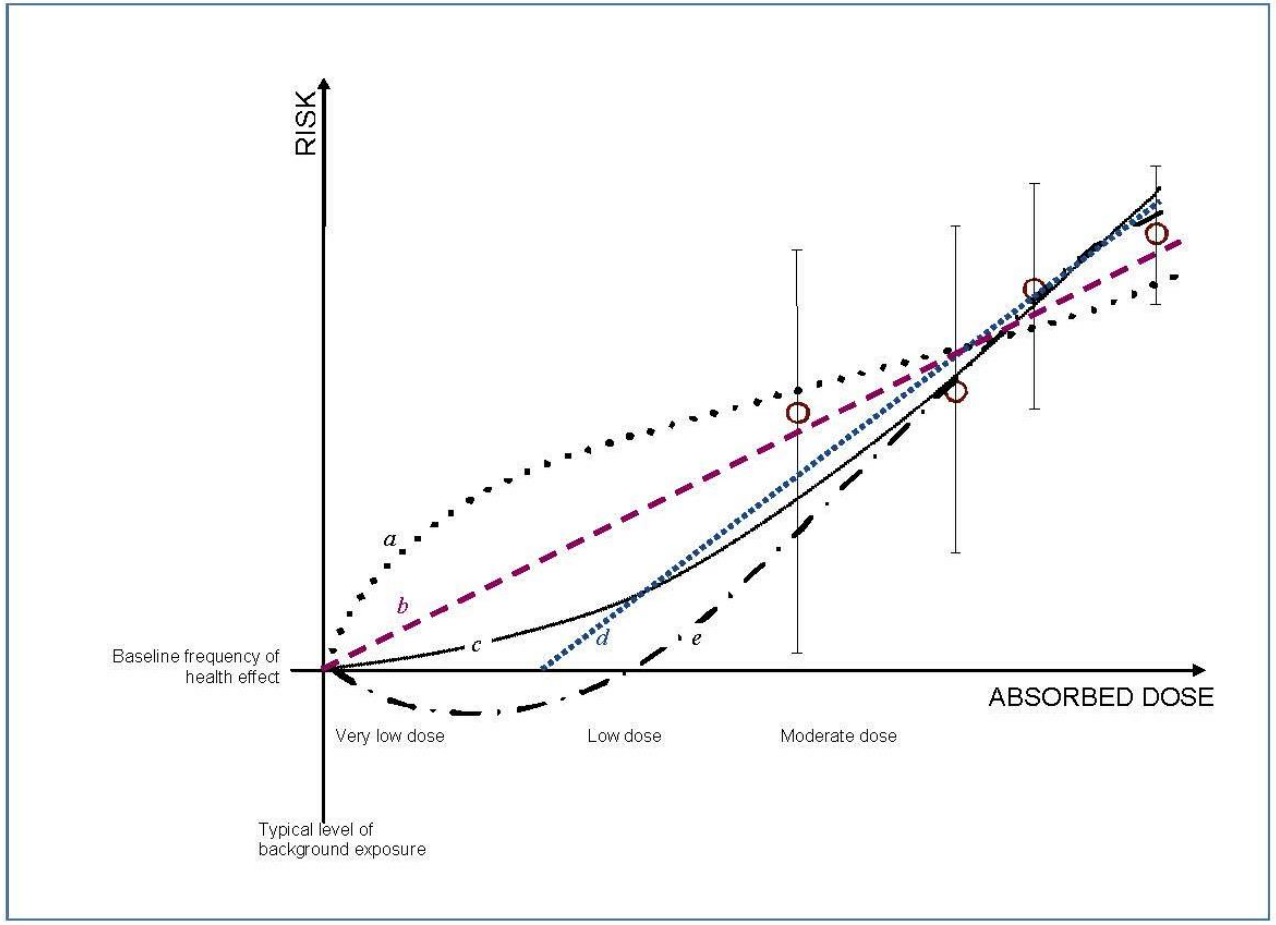
Dose - Response

At present, current dose -response models are

- linear models for the risk of solid cancers, and
- linear-quadratic for the risk of leukemia
- The Linear No Threshold (LNT) dose-response assumption provides a pragmatic basis for the use of effective dose as a radiation protection quantity and allows for the addition and comparison of external and internal doses of different magnitudes.
- However, other models can be envisioned.

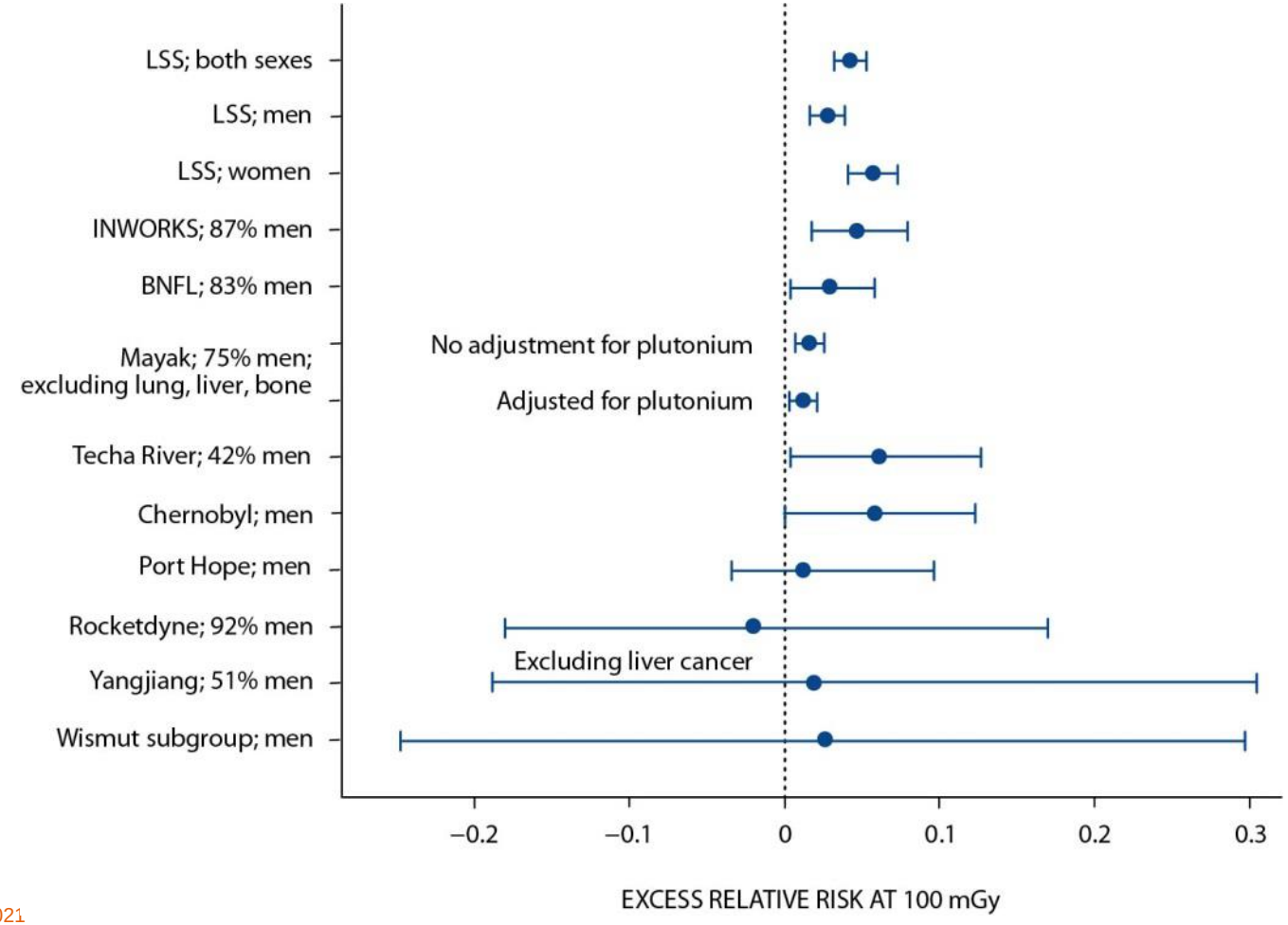
Schematic Presentation of Plausible Dose-Response Relationships for the Risk of Cancer

After UNSCEAR 2012 Annex A Figure 2



Excess Relative Risk at 100 mGy for Solid Tumours

after UNSCEAR 2019 Annex A



Dose Response for Radium-226

The LHS Figure(After Rowland 1978) illustrates a “practical threshold”

The RHS Figure (After BEIR IV) suggests that the LNT model is extremely conservative

Figure 2.1

DOSE-RESPONSE CURVE

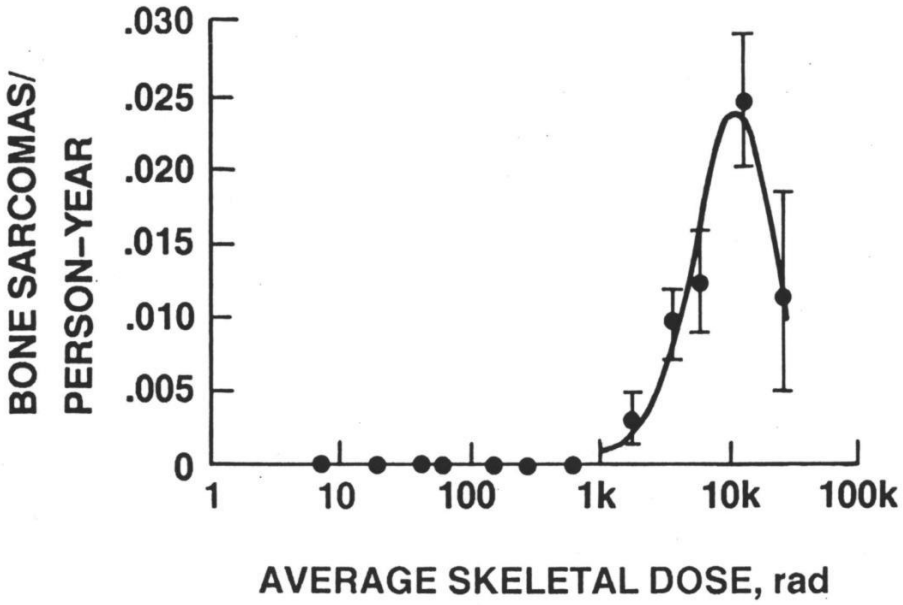
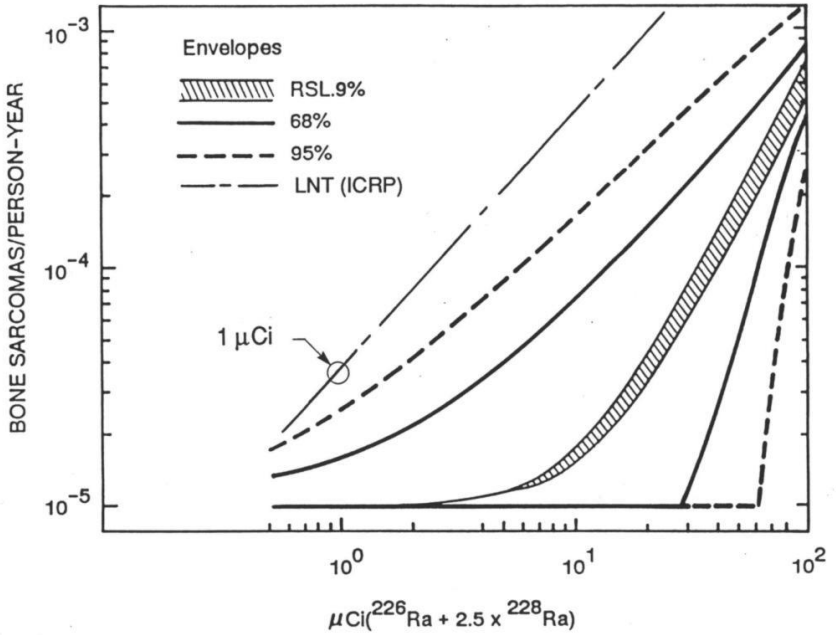


Figure 2.2

DOSE-RESPONSE ENVELOPE FOR ^{226,228}Ra



Tissue reactions (Cataracts)

Since ICRP 201, deterministic effects have been referred to as tissue effects

Classified as a deterministic effect

Historically:

- Threshold for cataracts = 5 Sv acute, > 8 Sv fractionated
- Dose limit to lens = 150 mSv

New recommendations:

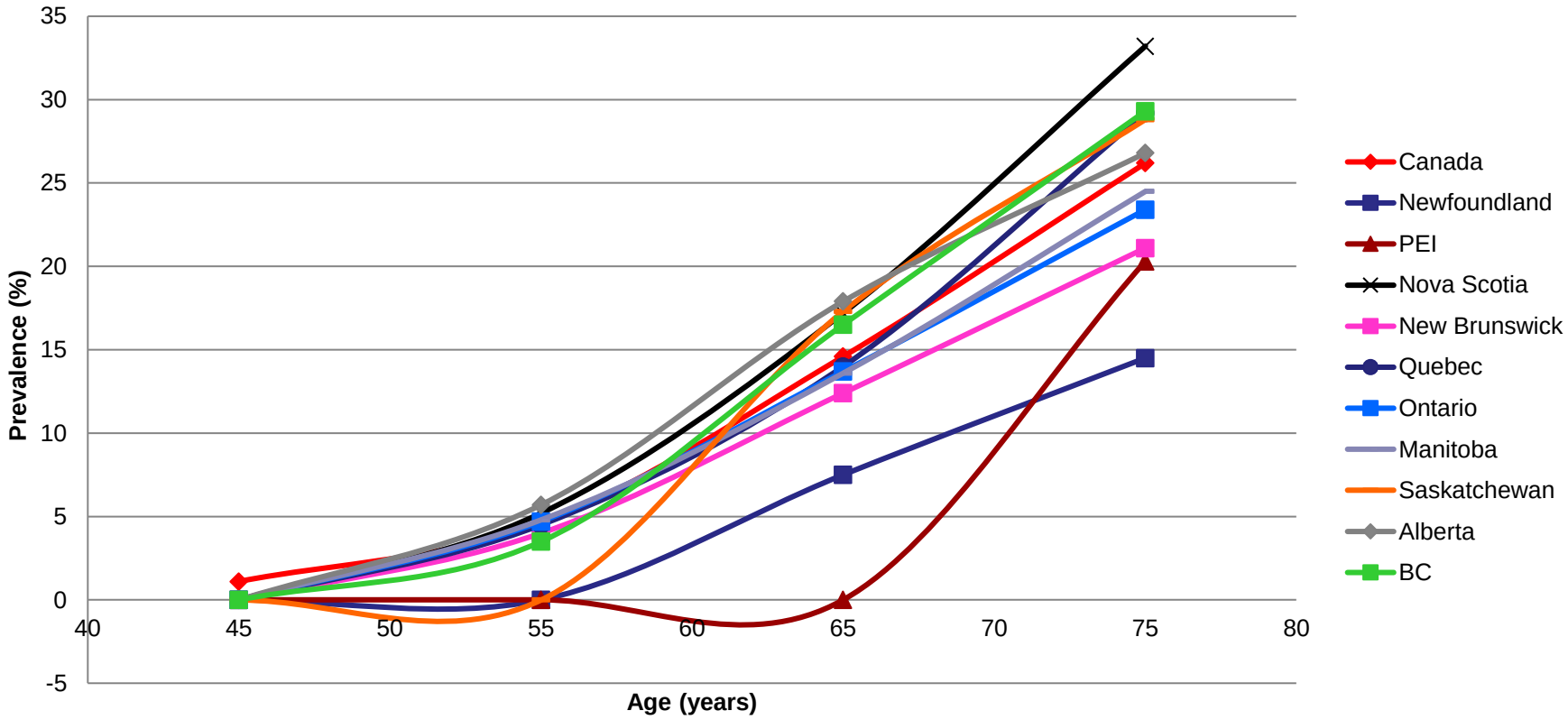
- Threshold for cataracts = 0.5 Gy acute or protracted
- Dose limit to lens = 20 mSv average

Changes based on recent epidemiological data

But there is uncertainty about the results as illustrated in the following slide

Prevalence of Cataracts

Natural prevalence in Canadian Males (SENES 2013) illustrates one of the challenges with epidemiology of cataracts



Detriment

- Harmful radiation-induced health effects are classified as ‘stochastic effects’ (cancer and heritable diseases) and ‘
- Harmful tissue reactions’ occur at high whole-body doses (>0.5 Gy) for acute and protracted exposure
- The concept of detriment used to quantify the harmful effects of radiation exposures at low doses or low dose rates on (various measures of)health
- The discussion paper of Clement, W Rühm, J Harrison, *et al.*, suggest that late developing effects (opacity, circulatory system) need to be considered in the expression of harm.
- In the authors opinion, discussion of the potential harm from such effects is appropriate, but the inclusion of such effects with stochastic effects (cancer and heritable effects) , in particular, **cataracts does not seem appropriate for inclusion the detriment**

Summary

- The ICRP review of the system of radiological protection is timely
- The work of the ICRP must be **scientifically sound**
- The system of radiation protection is complex
- Effort should be made to provide lay readable summaries (or short stand-alone documents) of key aspects of ICRP reports and recommendations
- ICRP needs to continue/expand stakeholder communications
- A few suggestions for consideration by the ICRP are provided in the body of the paper