Translating Science to Recommendations

NCRP Council Committee 1

Donald A. Cool

Co-Chairman, CC-1

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  - Technical Executive, Radiation Safety
- **International Commission on Radiological Protection**
  - Main Commission
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- **National Council on Radiation Protection and Measurements**
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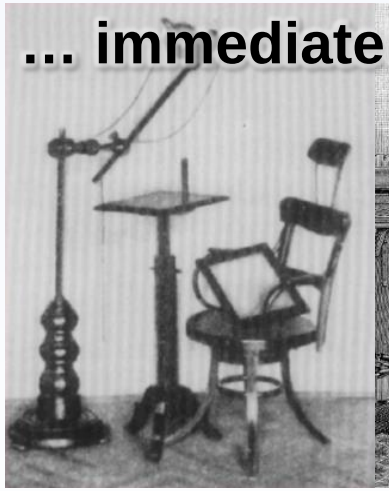
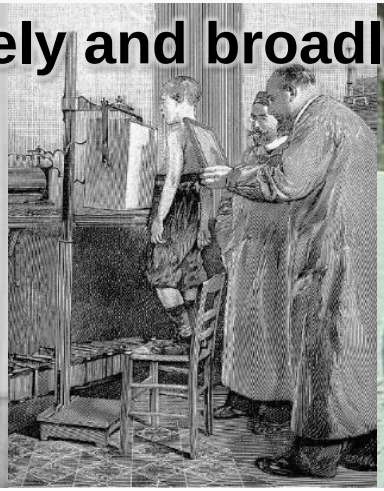
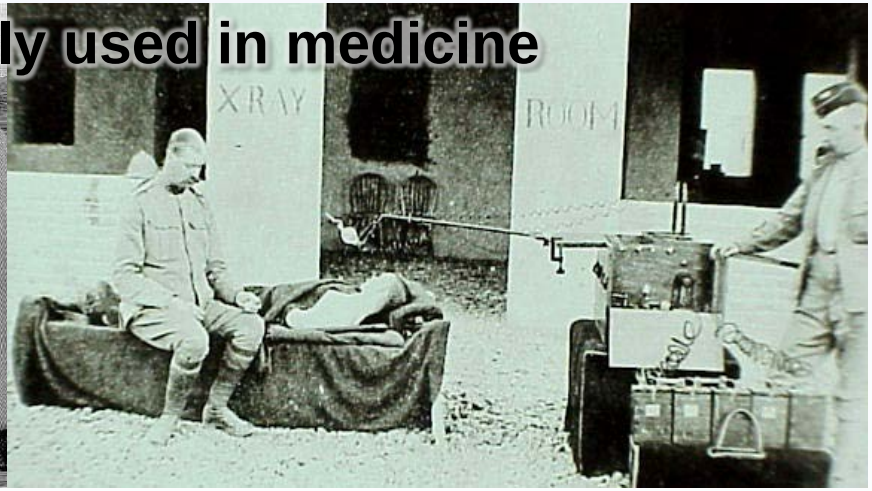
1895: Wilhelm Roentgen discovers x-rays…

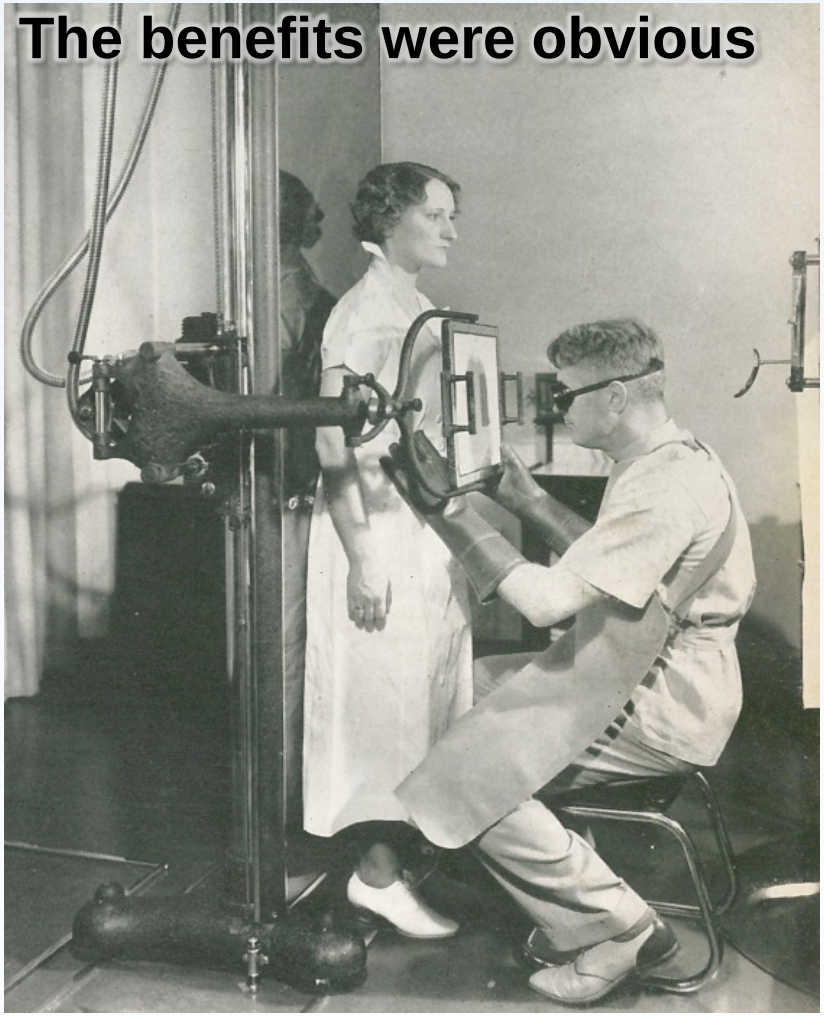
… immediately and broadly used in medicine



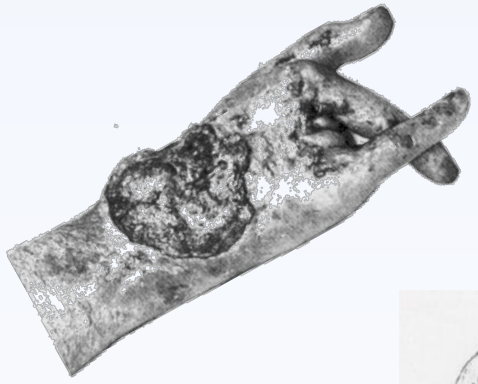


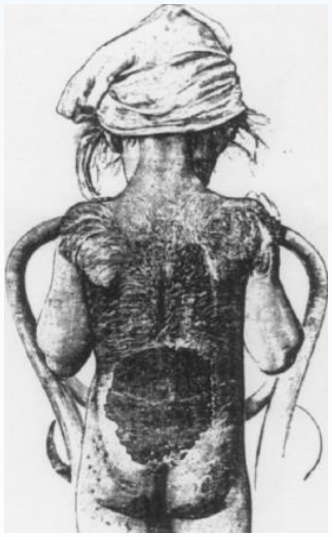


The benefits were obvious



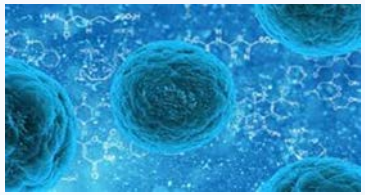
But hazards also begin to become clear





The Evolution of Protection

- **We built the protection system for sources we introduced**
- **Protection Objectives**
  - Manage **harm**: prevent deterministic effects
  - Manage **probability of harm**: reduce exposures ALARA
    - Genetic
    - Cancer





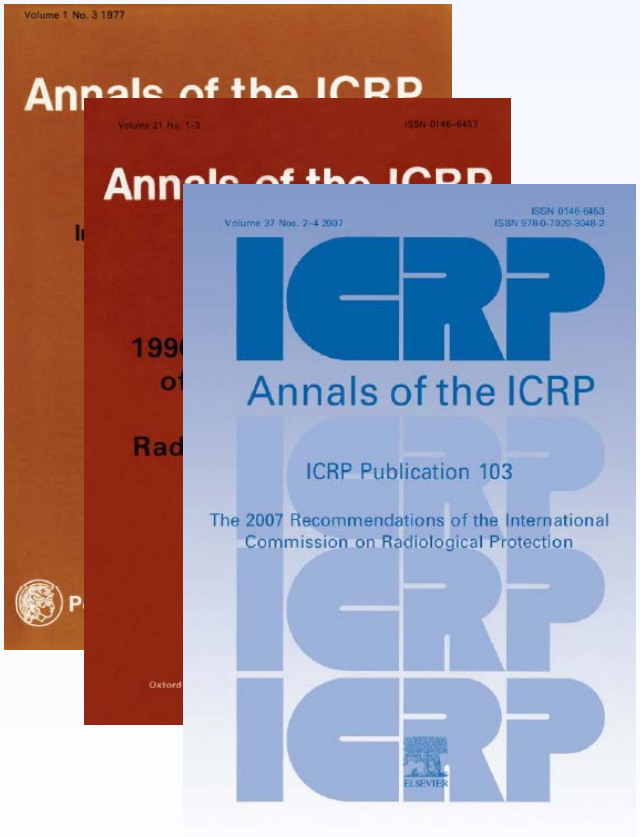


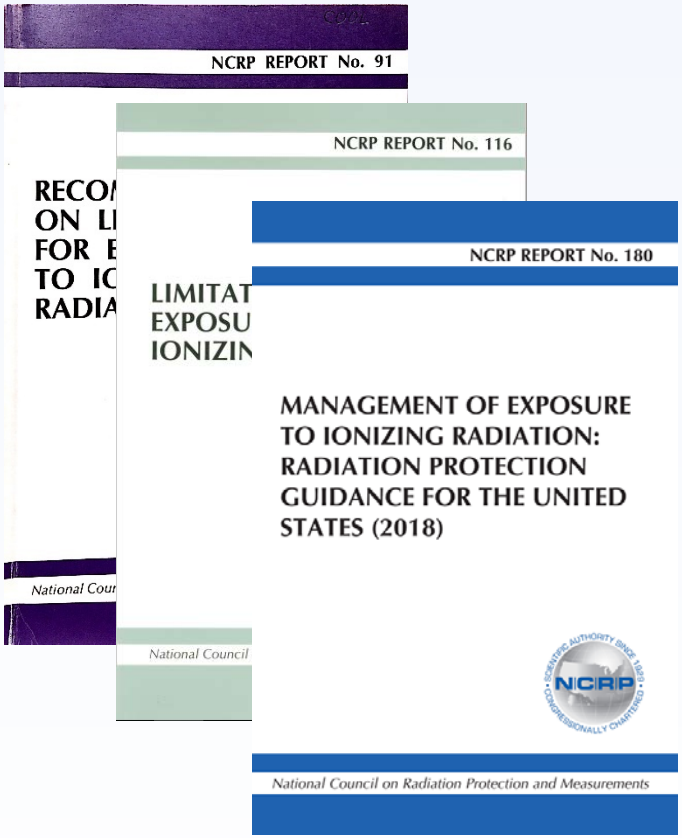


Recommendations reflect what we know in context of society

History of Recommendations

- **NCRP Reports 39, 91, 116, 180**
- **ICRP *Publications* 26, 60, 103**

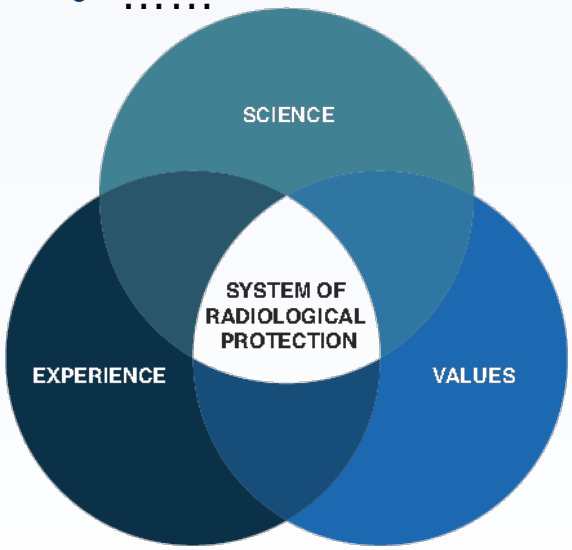




Continued process of evolution, refinement

Foundations

- **Social and Ethical Principles/Values**
  - Beneficence
  - Non-maleficence
  - Justice
  - Autonomy/Dignity
    - Prudence
    - Reasonableness
    - Tolerability
    - Accountability
    - Inclusiveness
    - Conservation/biodiversity/ sustainability
- **Science**
  - Epidemiology
  - Radiobiology
  - Anatomy
  - Physiology
  - Metrology
  - ……
- **Experience**
  - Hiroshima/Nagasaki
  - Nuclear Installations
  - Industrial/Medical
  - Chernobyl
  - Fukushima
  - ……



Foundations shape approach to Recommendations

Goal

- **Adequately protect humans and nonhuman biota against adverse effects known to be associated with radiation exposure.**
  - Prevent occurrence of acute and chronic radiation-induced tissue reactions (deterministic effects) in humans;
  - Reduce the probability of stochastic effects (primarily cancer) in radiation-exposed persons while maintaining the benefits to the individual and to society from the activities that generate such exposures; and
  - Protection of the Environment through focuses on population maintenance of the affected non-human biota,
- **Without unnecessarily limiting the benefits to humans that may result from such exposure.**

Does everyone agree on how to accomplish this?

Do we have a consensus on the science?

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NO

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Approach

- **Council Committee**
  - Diverse Membership … all PAC's involved
  - Ethical and Environmental interests represented

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- **Look to previous NCRP work when possible**
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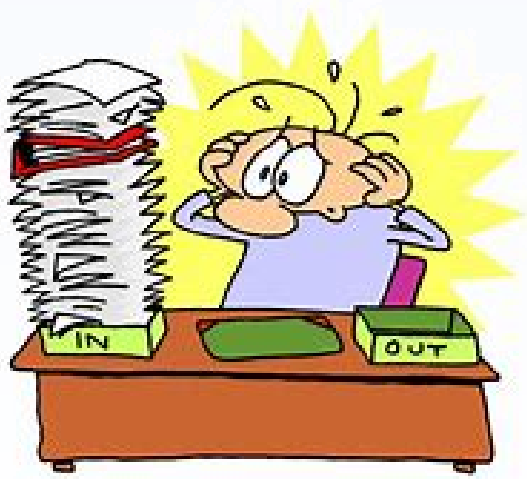
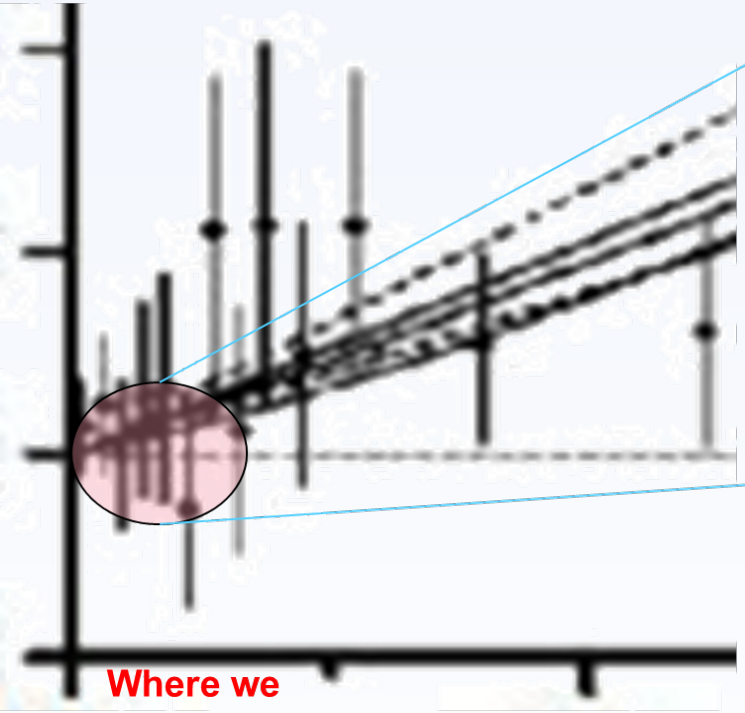
- **Discussion, Debate, Challenges**
  - Working out the "what" for each recommendation
  - Sorting out the "why"

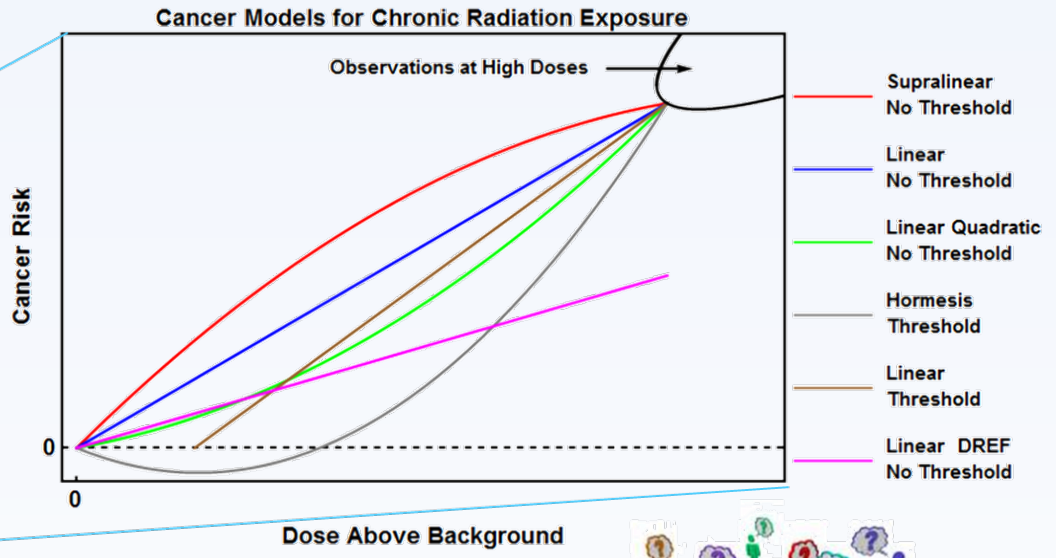
Challenge

- **Previous NCRP Recommendations were 25 years old**
- **ICRP Recommendations were 10 years ago**
  - What did we learn?
- **Need to cover many topics not previously considered**
  - Growth in Medical
  - Ethics, Stakeholders, Safety Culture
  - Environment
- **How to best reflect all the lessons learned and operational experience that have occurred**
  - Fukushima

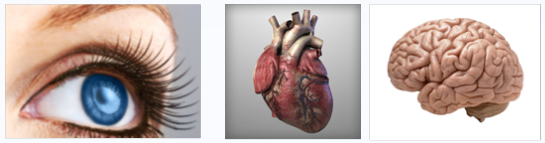


Many Factors to be Considered





Where we have great uncertainty



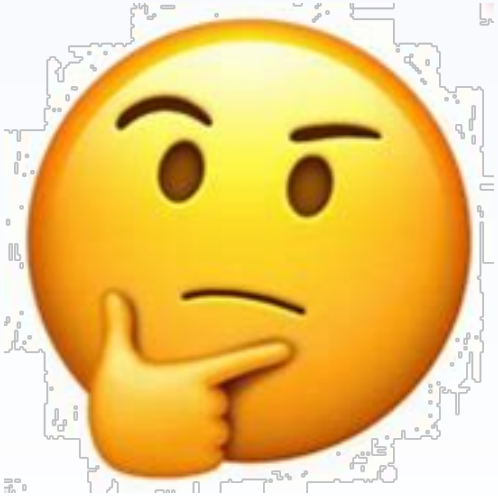
Non-Cancer Effects

Environmental Effects

Individual Sensitivity

Fundamental Questions

- What may no longer applicable?
- What is not working?
- What new information do we have?
- What things have not been addressed?
- What experiences need to be reflected?
- Where are there controversies?

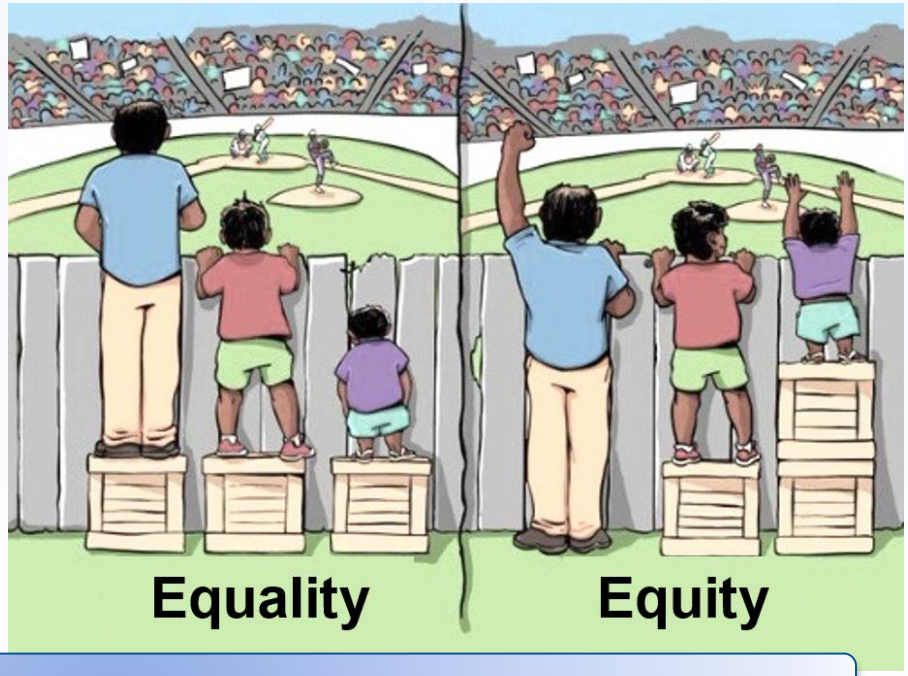


Fundamental Questions

- **How can protection be improved in daily activities?**
  - Are recommendations, regulations, guidance, and operations informed by the best science and experience?
  - Are we doing the right work, in the right way, at the right time?
  - Where are opportunities to reduce the source?
  - Can technology help us to further reduce exposures?
- **How can the recommendations best help to answer these questions?**

Fundamental Questions

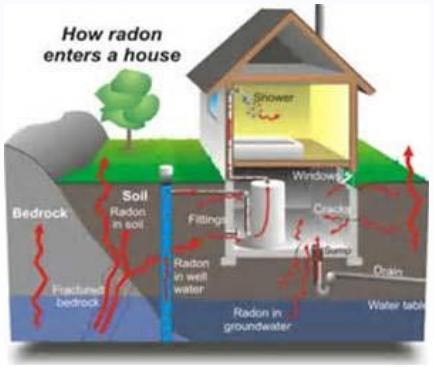
- **What is the right thing to do for the situation and circumstances?**
  - Are all hazards addressed?
  - Are all the risks balanced?
  - What is Reasonable, Fair, Just?
  - What is Equitable?



If you have the information, it is reasonable to respond to individual needs

Challenges

- How to coherently apply RP System to natural sources and the aftermath of an emergency?
- How does protection of the environment fit into the picture?
- What is tolerable, or acceptable, in a particular situation and prevailing circumstance?
- How to properly balance social and economic factors?
- Who has authority or ability to take actions?



Challenges

- System must apply to everyone … but
- Would you protect these stakeholders in the same way?
- How long will the situation and prevailing circumstances continue?
- How do you answer their questions?
- How can they start to take control of their situation?
- Help them, not tell them …

CAUTION

Indiscriminate use of Jargon may be detrimental to your credibility

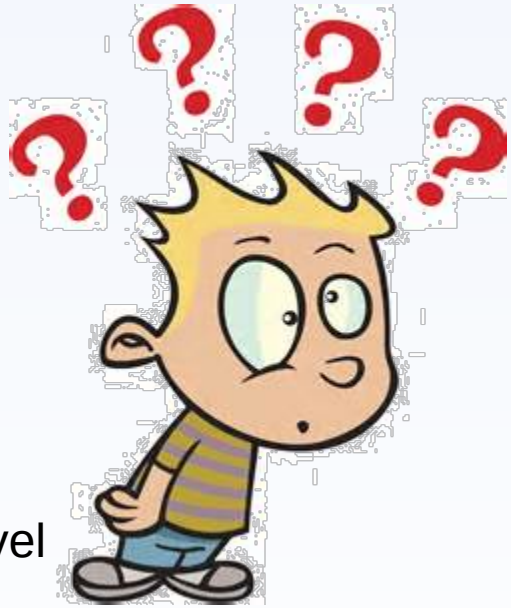
So the Answer is Simple … Right?

Diagnostic Reference Level

Effective Dose

Stochastic / Non-stochastic

Occupational



Existing Exposure Situation

Optimization

Gray, Sievert, Rad, Rem

Planned Exposure Situation

Limit

Constraint / Reference Level

Medical

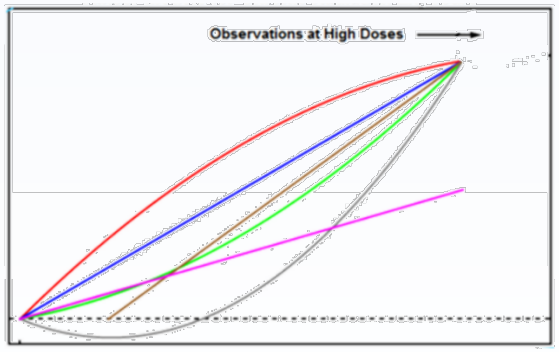
Public

Emergency Exposure Situation

Absorbed Dose

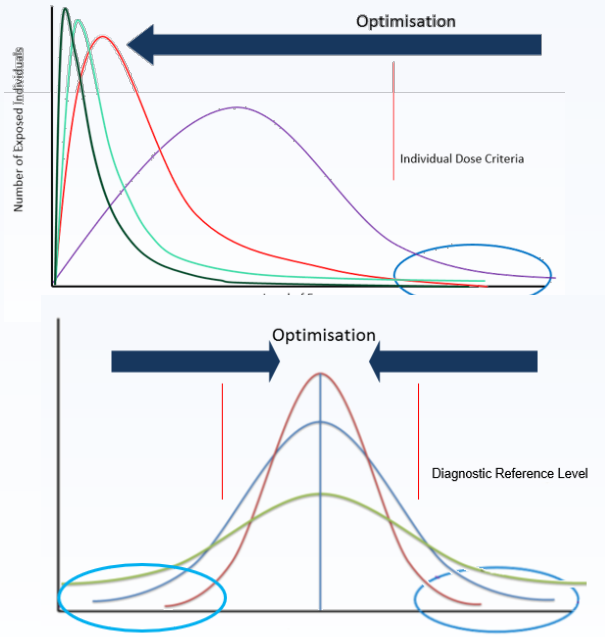
Conclusions

- **System of protection works and should be continued**
- **For purposes of implementing the system of radiation protection, NCRP reaffirms the linear non-threshold (LNT)**
  - Thresholds, negative, and positive effects are all seen in molecular and cellular systems
  - Observations cannot be generalized into a relationship that predicts a universally applicable response
  - Lungs are different from colon, or skin, or breast. Males different from females, children more sensitive in some cases than adults
  - Management system must provide for consistent, predictable, ethical approach for everyone – and simple enough to apply
- **Risk Assessment and Risk Management are not the same thing**



Conclusions

- **Optimization of Protection (ALARA principle) applies in all situations**
  - The outcome of the optimization of protection will be unique to the exposure situation, and the particular circumstances.
  - Protection outcomes should not be driven beyond the point where societal, economic and environmental factors outweigh the radiological hazards.



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- **Exposure situation characterized by:**
  - Nature of the source
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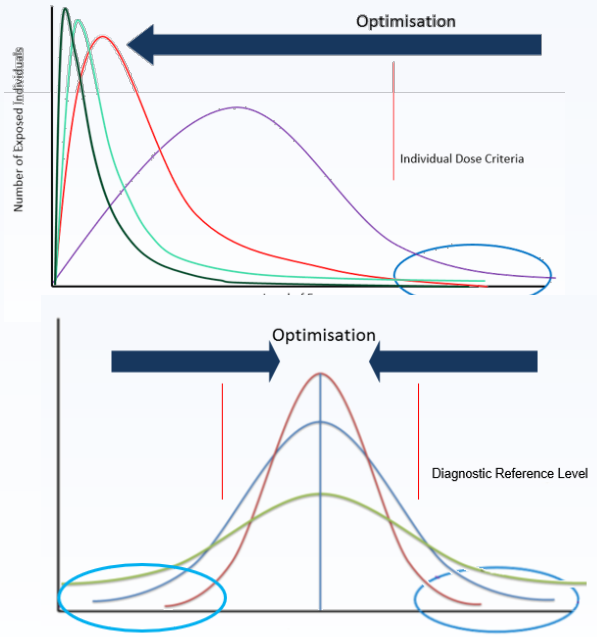
  - Circumstances of exposure
  - Ability of those with authority to control the:
    - Source of ionizing radiation
    - Actions of the persons at risk of exposure



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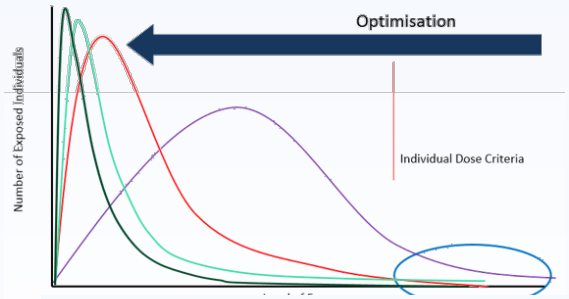
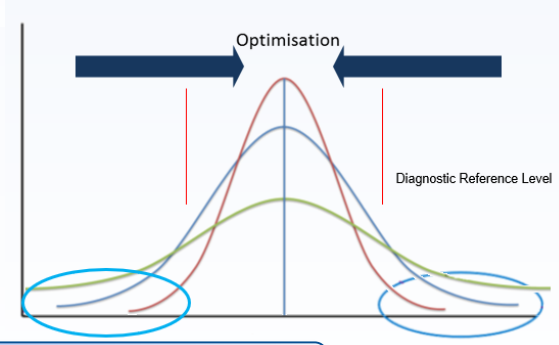




The Key is being Reasonable !

Conclusions

- **Numeric Protection Criteria for Control of Dose to an Individual**
  - Criteria are influenced by the knowledge and type of the source, the existence of an appropriate radiation control program, and whether that program can be established in advance of source introduction
  - Limits are a special case of the Numeric Protection Criteria, only for use in specific situations when the source is stable, characterized, and the responsible organization has established an appropriate radiation control program in advance of source introduction
  - Do not apply to patients

Conclusions

- **Needed a new category of exposure to properly differentiate responders in emergencies**
  - Emergency workers engaged in life-saving activities or actions to prevent a catastrophic situation controlled by recommendation on decision dose to prevent deterministic effects
  - Dose received during emergency activities is not counted against either public or occupational exposure
  - Emergency workers are not precluded from returning to their normal activities and occupations.



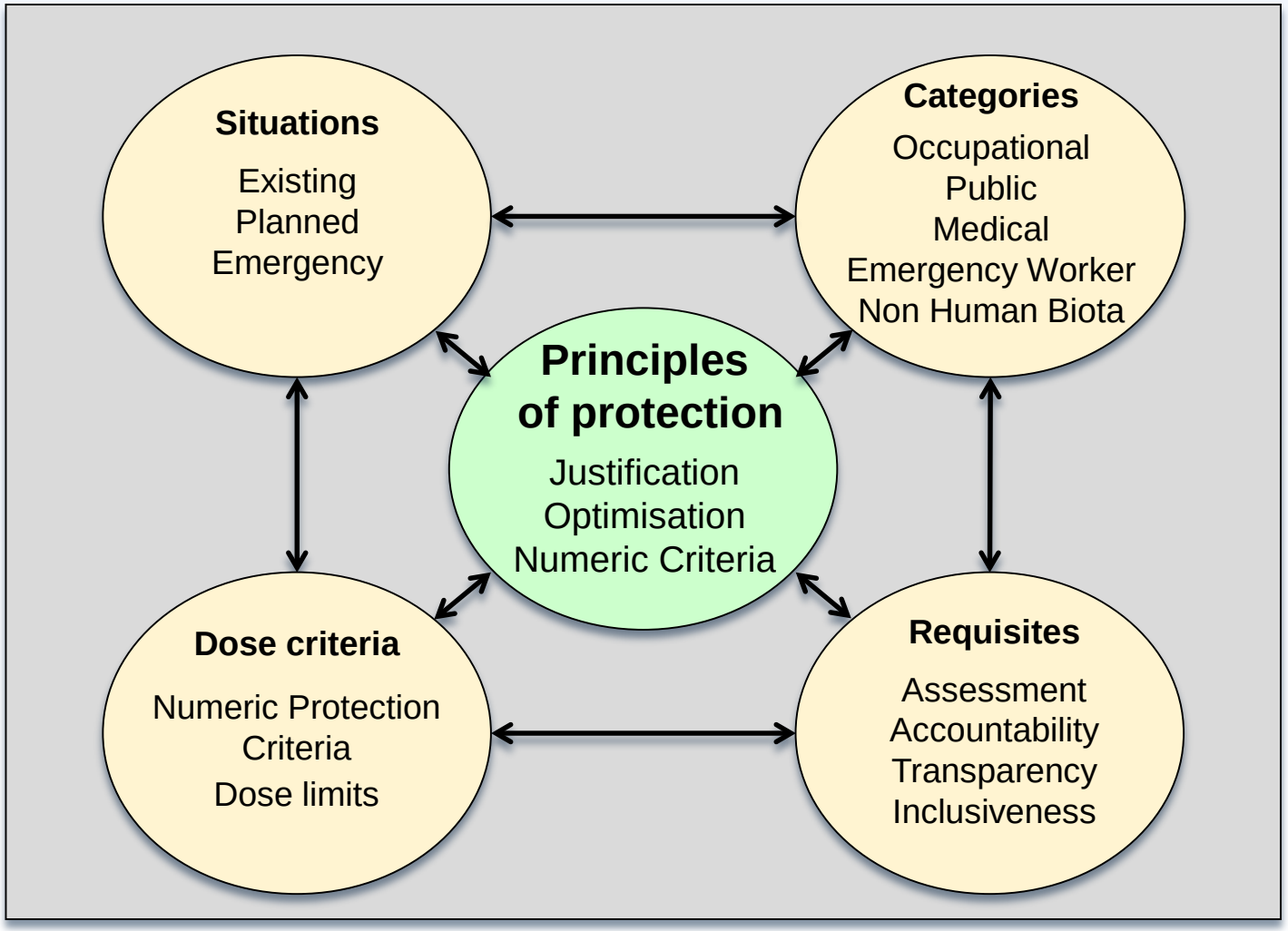
Conclusions

- **Needed a new category of exposure to properly deal with the Environment**
  - Address in justification and optimization of the source
  - Dose limitation is not appropriate
  - Context of National Environmental Policy Act
    - Options available to be considered can be informed by environmental radiation dose, just as they are informed by other factors
  - Tools exist and continue to be developed
  - Criteria given to guide when additional attention is needed

Conclusions

- **Societal views and involvement must be reflected**
  - Ethical values support decision-making, particularly in complex situations.
  - Stakeholders are key in making decisions concerning the management of their radiation exposure and the achievement of sustainable and suitable decisions.
  - Psychosocial effects are an important factor in all hazard optimization of protection
  - A strong safety culture is intrinsic to effective radiation protection programs.

System of Protection



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