Ethics of Radiological Protection in Occupational Exposure Situations

Science Aspects

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Outline

• Dose-Effect Relationships
• Protection Paradigm
• Non-cancer Effects
• External vs. Internal Exposure
• Radiation in the context of other Hazards
• Accidental Exposures

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Dose – Effect Relationship

- Linear response is assumed for purposes of the system of protection
  - Risk Assessment and Risk Management are not the same thing
  - 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, equitable and ethical approach

Would we do things differently if we knew the shape of the response better?
Protection Paradigm

- System of Protection based on:
  - Justification
  - Optimization of protection
  - Limitation of dose to individuals

- Optimization:
  - As Low As Reasonably Achievable
    social and economic factors taken into account

- Limitation of Individual Dose
  - Not just dose limits, but constraints and reference levels

What does reasonable mean?

Values of individual dose are always necessary to guide protection actions
Non-Cancer Effects

- Effects are known to occur at higher doses for lens of the eye and for the cardiovascular system
- Dose limitation recommendations have been reduced for lens of the eye
- Debate continues on the extent to which cardiovascular and cerebrovascular effects occur at lower dose and dose rates
- Calculation of detriment does not take these effects into account

Do occupational protection programs need to be modified?
Effective Dose based on equivalence of internal and external exposure

Some radionuclides deliver the dose over a long period of time, while the committed effective dose is assigned to year of intake

Occupational protection programs, particularly in nuclear power operations, have tended to emphasize reductions in internal exposure

Is being contaminated worse than being exposed?

How does dose effect relationship impact internal vs. external?

Are perceptions, behaviors, and science aligned?
Radiation in the Context of Other Hazards

- Occupational exposure occurs in many contexts
- Protection needs to be provided for all hazards
  - Heat Stress
  - Trip and Fall Hazards
  - Chemicals
  - Smoke
- Protective equipment may make doing the task difficult, slow things down

Are we providing the best protection for all hazards present?
Occupational activities pose the possibility of accidents
Exposures greater than 100 mSv possible, depending on circumstances and needed activities to respond to event
  - Protection for acute effects as well as stochastic effects
  - Consideration of different radiation fields; e.g. high beta or alpha activity
  - Decisions to continue work, or turn back

Scientific information suggests that older individuals are less sensitive, so do they become a priority for responding?

Accident dose implications to returning to normal activities and employment