IREP after BEIR VII

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Overview

- IREP is an example of quantitative uncertainty analysis (QUA)
  - Ionizing radiation is a known and well-quantified cancer risk factor
  - Risk estimates are uncertain
  - But we know a lot about these uncertainties
  - And we can address implications for risk

Elements of the approach

- Take a problem apart
- Identify component parts
- Evaluate their uncertainties and how they fit together
- Evaluate the overall uncertainty of the solution

Legal Basis for Adjudication of (Some) Compensation Claims

- IREP is mandated in the US for adjudication of some claims against the government for radiation-related cancer
- Energy Employees' Occupational Illness Compensation Program Act of 2000 (EEOICPA), P.L. 106-398

Rationale

- We know a lot about radiation-related cancer risk in exposed populations
- We can estimate site-specific ERR, by exposure history and age following exposure
- In an exposed population, the proportion of cancers that would not have occurred in the absence of exposure is estimated by Assigned Share, AS = ERR/(1+ERR)
- This population quantity can be used as a guide for adjudication of individual cases

NIH Radio-Epidemiological Tables Background

- 1985 NIH report: Congressional mandate (P.L. 97-414)
  - Requiring periodic update
  - Essentially, summary of mainstream scientific information
  - VA the main user: claims based on service-related exposure
  - CIRRPC screening tool: upper uncert. limit for AS = ERR/(1+ERR)
  - VA claim adjudication based on CIRRPC screening tool at 99%
- 2003 NCI/CDC report requested by VA
  - Intended as an interim update, requiring revision after BEIR VII and new A-bomb survivor data
  - Targeted to VA requirements, eg, 99% upper uncertainty limit

2003 NCI/CDC Report

- Based on scientific consensus
  - Small working group (NCI, CDC, SENES Oak Ridge)
  - Group of scientific and lay advisors
  - Formal IOM expert review panel
- Calculations based mainly on A-bomb survivor cancer incidence data
- Emphasis on uncertainty analysis
- Interactive Radio Epidemiological Program (IREP) replaced NIH tables

EEOICPA

- Enacted December 2000; P.L. 106-398
  - DOE and DOE contractor employees
  - Adjudication by DOL
  - NIOSH to provide doses, support
  - Use NIH tables as may be updated
  - Mandated use of upper 99% limits on AS
- IREP modified by NIOSH for administrative reasons (NIOSH-IREP)
  - A few differences for certain cancer sites

Components of IREP: Input

- Individual characteristics
  - Sex
  - date (year) of birth,
  - type of cancer
  - date (year) of diagnosis
  - Smoking history (if lung cancer)
- Exposure history: for each exposure,
  - Date (year)
  - Dose estimate and its uncertainty distribution
  - Radiation quality (photon, neutron, energy, etc.)
  - Chronic or acute exposure

IREP: Calculation components

- For each exposure, compute ERR (with uncertainty) for specified diagnosis & date, and apply
  - **Uncertain minimum latent period**
  - **Uncertain radiation effectiveness factor for specified radiation**
  - **Uncertain DDREF for chronic or low-dose, acute exposures**
  - **Adjustment for smoking history, if applicable**
- Sum ERR over exposures
- Apply uncertain transfer factor, if applicable, for ratio of Japanese to US cancer rates
- Combine uncertainties (Monte Carlo simulation)
- Transform ERR and its uncertainty to Assigned Share: AS = ERR/(1+ERR)

BEIR VII (in press)

- A highly authoritative review of mainstream science on radiation-related risk
- Risk estimates modeled mainly on latest A-bomb survivor tumor registry and mortality data, using DS02 reconstructed dose
  - Projection over time since exposure is more secure
- Also, data from other exposed populations
- Dose-response models generally similar to those used for IREP, different in some details

BEIR VII (cont)

- Considerable attention to DDREF and population transfer
- Based additive transfer on EAR rather than on a multiple of ERR determined by population rate ratios
- Tended to use fixed, rather than random, mixture probabilities
  - e.g., .33 × EAR + .67 × ERR, rather than
  - p × EAR + (1 – p) × ERR, where p is random

Conclusions

- IREP can be improved by adopting the models and risk estimates of BEIR VII
- Because the BEIR VII estimates are based on more data, the uncertainties in IREP probably will be reduced
- Unless the new estimates are higher, site-specific upper uncertainty limits for AS probably will be lower than at present

Links to IREP

- The DCEG web page is at http://www.dceg.cancer.gov/
- Click on "Tools & Resources" and then on "Algorithms for Expression of Risk", under "Radiation Epidemiology Branch tools"
- This gets a paragraph of text.
- In 4th line, click NCI Monograph to get .pdf file of NIH-CDC report
- Clicking on Judy Patt (pattj@mail.nih.gov) allows you to order a bound copy of the report (at no charge)
- http://www.irep.nci.nih.gov/ brings up the original IREP program, which you can run online
- In the last line, NIOSH-IREP takes you to the NIOSH OCAS web site