

ASSESSMENT AND MANAGEMENT OF RISK FROM RADIOLOGICAL HAZARDS

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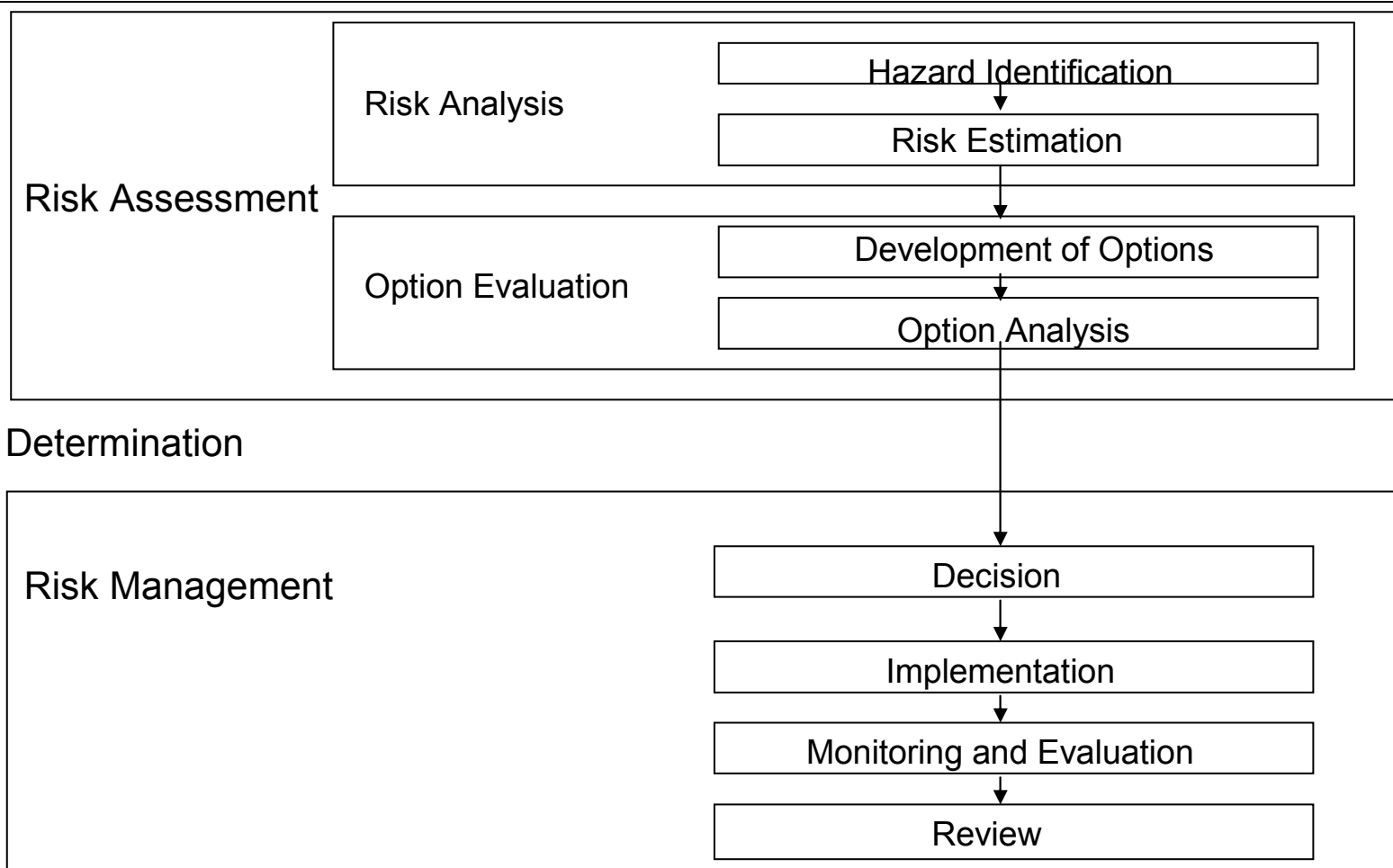
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Health Canada Risk Assessment/Risk Management Framework



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RADIATION PROTECTION STRATEGY

- Risks and benefits of radiation recognized early
- Risk reduction strategies developed in parallel with use
- Balance risks and benefits
- Evolved with new knowledge
- Strategy contains elements of HC and workshop framework



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RISK ASSESSMENT – HAZARD

- Ionizing radiation
- Natural and artificial sources
- ~ 50 radionuclides of concern
 - abundance
 - toxicity
- Deposit energy in matter – chemical changes cause biological damage
- Damage caused by well-understood mechanisms



SHORT-TERM EFFECTS OF RADIATION EXPOSURE

Dose (Sv)	Effect
0.1	Chromosome changes (threshold)
0.5	Blood count changes
1	Vomiting
1.5	Mortality (threshold)
3-5	L_{D50}
8	100% mortality



LONG-TERM EFFECTS OF RADIATION EXPOSURE

- Appear years later (5 years to a lifetime)
- Likelihood of occurrence depends on amount of radiation received
 - **CANCER** (leukemia, thyroid, lung, bone, breast, skin, other tumours)
 - ***In utero effects*** (effects on developing baby caused by exposure of the mother during pregnancy)
 - **Genetic effects** (effects on future generations caused by exposure of either parent before conception)



RISK ASSESSMENT - ESTIMATION

- Based on long-term follow-up studies of human populations exposed to high doses of radiation
 - Survivors of atom bombs in Japan
 - Uranium miners exposed to radon
 - Radium dial painters
 - Patients treated with high doses of x-rays or radionuclides
- At lower dose need appropriate dose response model to extrapolate from high-dose effects
- Additional information from experiments on animals
- Considerable uncertainty at low levels – extrapolate beyond conditions under which data originally collected



- Risk estimates made by:
 - United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
 - International Commission on Radiological Protection (ICRP)
 - United States Committee on the Biological Effects of Ionizing Radiation (BEIR)
- Estimates based on rigorous science, peer-reviewed publications
- Estimates by committees in good agreement



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DOSE RISK MODEL

- Linear no-threshold (LNT) hypothesis:
 - There is no “safe” level of radiation exposure
 - All exposures carry some level of risk
 - The risk is directly proportional to the exposure
- Form of Precautionary Principle



RADIATION RISK FACTOR

- Estimate of probability of radiation-induced cancers
- Based on extrapolations
- ICRP recommends:
 - For each Sievert of exposure to radiation in the general population, risk of fatal cancer is **5%** or:
5 cases per 100 people
 - Therefore at 1 mSv the fatal cancer risk is:
50 cases per 1million people



RISK MANAGEMENT

- Strategy based on balance of risks and benefits
- ICRP – internationally recommended system of radiological protection
- Three basic principles
 - Justification – net benefit to society
 - Optimization – ALARA
 - Dose limitations



- Laws and regulations
 - Nuclear Safety and Control Act
 - Radiation Emitting Devices Act
- ICRP dose limits adopted by CNSC
 - occupational and public exposures
 - legal purposes
 - not exceeded



- Limits:
 - Occupational – 100 mSv over 5 years, 50 mSv in a year
 - Public – 1 mSv in a year
- Ensures no one exposed to unacceptable radiation risks
- Control at source for regulated practices
- Nuclear facilities apply ALARA – achievable levels – lower than legal dose limit
- Risk limited through ICRP recommendations, implementation by licensee and regulation by CNSC



- BEIR VII

- Supports previous risk estimates
- Strengthens confidence in estimates
- Supports linear no threshold risk model
- Recommends additional epidemiological research



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CONCLUDING REMARKS

- Challenge to develop programs to protect workers, public and environment
 - gaps in knowledge
 - uncertainties
- Uncertainty in risk estimates at doses < 50 mSv
- Precautionary approach in establishing strategies



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- Absorbed dose – amount of energy deposited by radiation in tissues and organs.
 - Independent of type and energy
- Extent of radiation damage depends on:
 - radiation type
 - organ sensitivity
- Weighting factors developed to account for variability
 - Effective Dose

