

Integrated Risk Analysis and Risk Communication for a 10 kT Event

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Risk communications serve recipients' needs if they

- are faithful to the science, both natural and behavioral
- focus on just the facts pertaining to recipient's pending choices
- provide a complete and coherent picture
- are delivered by accessible channels in accessible formats

In the context of a nuclear explosion, these communications goals imply...

- Need simple rules for action before, during, and after attack
- Rules should be compatible with minimal diagnostic and communication ability
- Rules should recognize peoples' diverse economic, social, and radiological circumstances

Policy: develop simple messages and scripts, evaluated in advance

Mental Models Approach to Risk Communication for Lay Decision Making

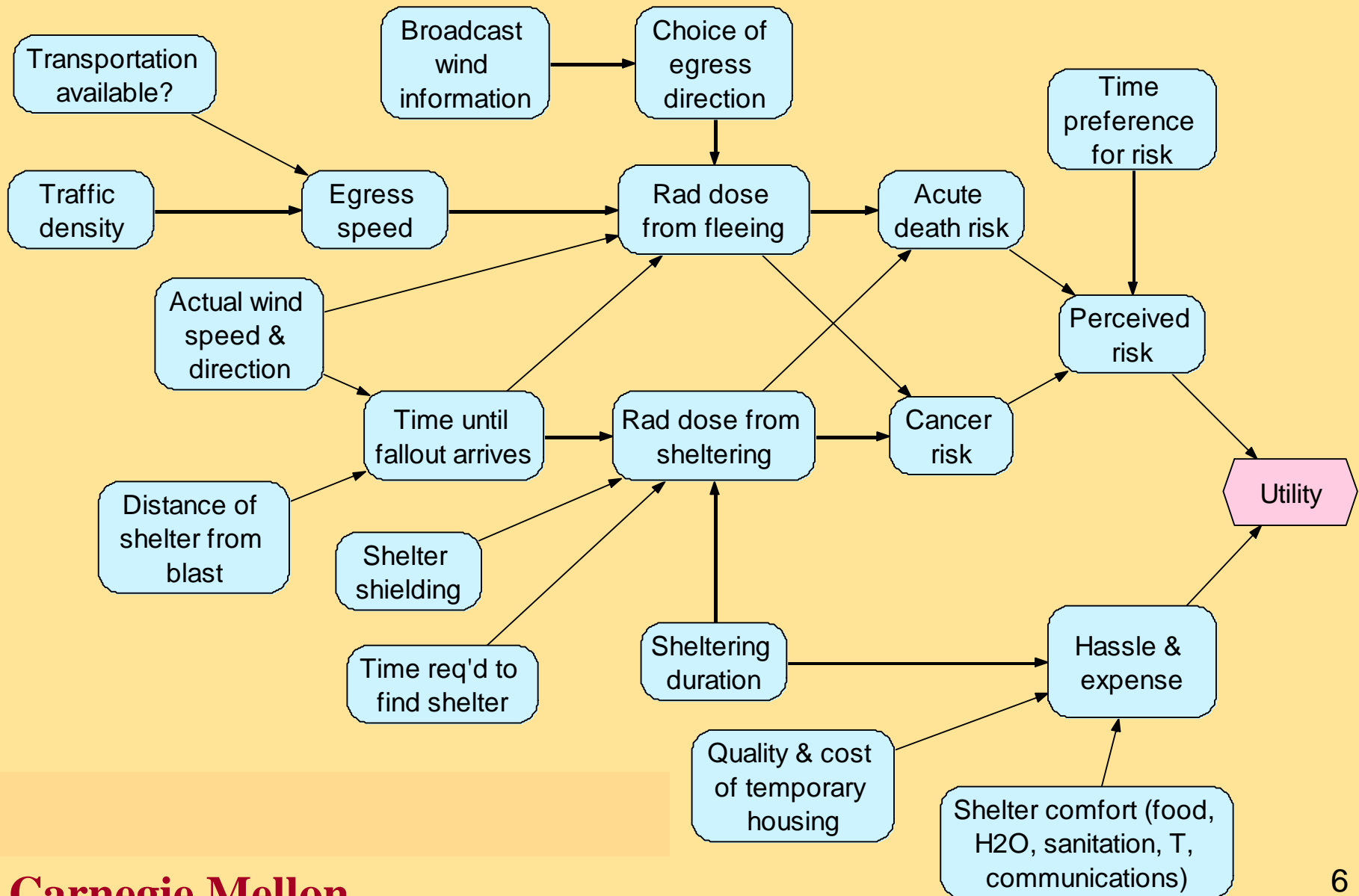
[Morgan et al. 2002]

1. Draw on technical and decision experts to create a normative model of the recipients' decision
2. Use structured interviews to elicit lay peoples' mental models of the decision domain. (e.g., "Tell me what you know about fallout.")
3. Compare expert and lay models to identify missing and erroneous concepts in lay understanding.
4. Use results to draft risk communication
5. Test and refine communication with target population

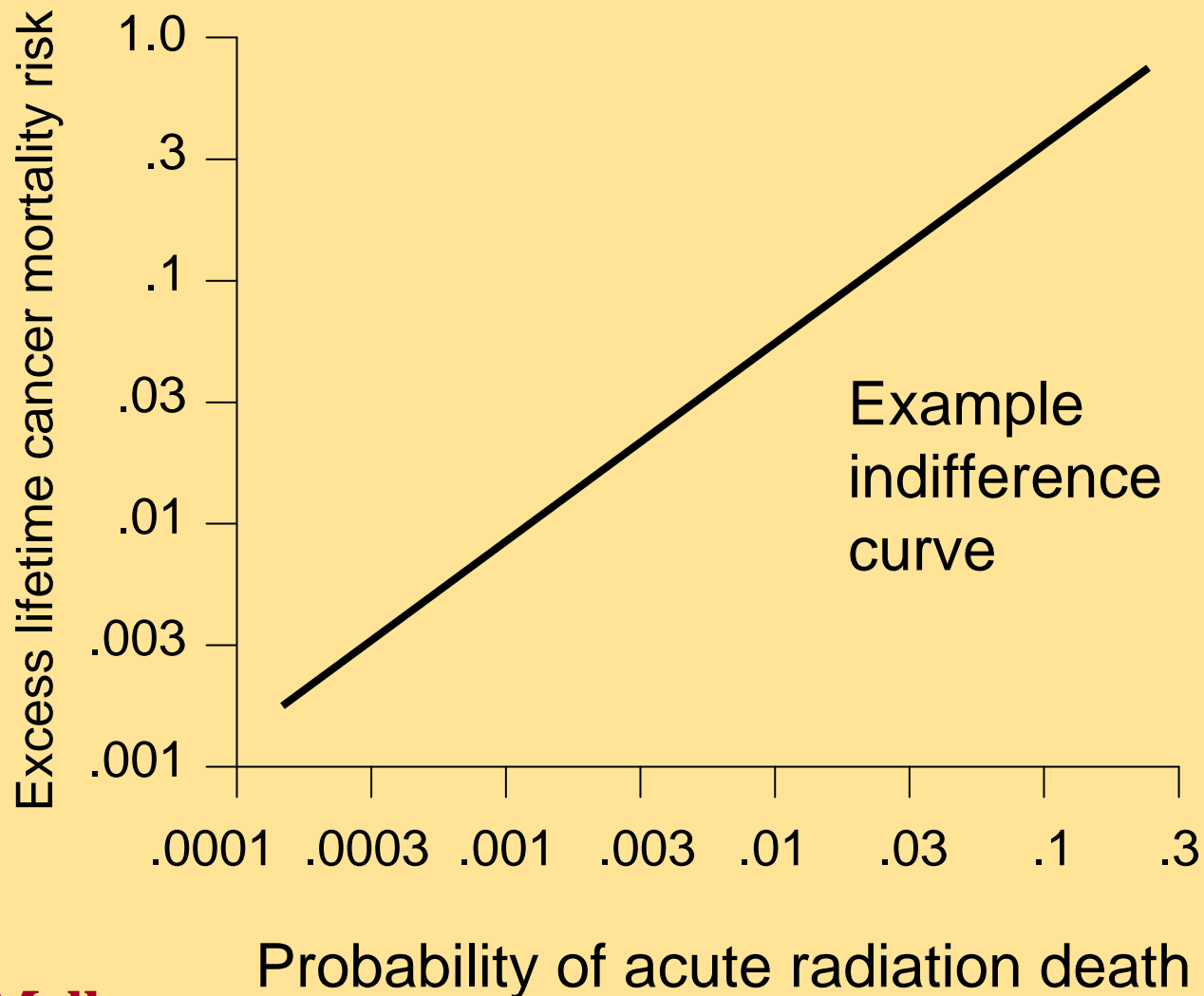
Pre- and post-blast decisions

- Should I make preparations (e.g., home supplies, emergency plan)?
- In the event of a blast, should I gather my family, gather supplies, shelter, or flee?
- Should I let someone who has been exposed to fallout enter my shelter?
- If someone in my shelter needs medicine, should I leave my shelter to get it?
- Should I drink the tap water?

Normative Model of Shelter or Flee Decision



Time preference for mortality risk



Interview technique for eliciting lay peoples' mental models of shelter or flee decision

- “Some people are worried that a terrorist group might be able to explode a nuclear weapon in a U.S. city. Can you tell me what people could do to protect themselves against such a possibility?”
- “You mentioned that the explosion would produce fallout. Can you elaborate?”
- “You mentioned that it would be good to hide in a basement. Can you explain why?”

Plausible results of comparing expert and lay models of shelter or flee decision*

- All subjects know about blast effects, but only 40% know about fallout.
- 20% of subjects believe that fallout is dangerous only before it falls out.
- 50% of subjects believe that radiation levels will remain high for thousands of years.
- Most subjects say that their first inclination will be to flee in their cars.
- 20% believe car can provide significant shielding.

* For example only. Research remains to be done.

Messages should be tested for compatibility with recipient's goals, knowledge, and resources

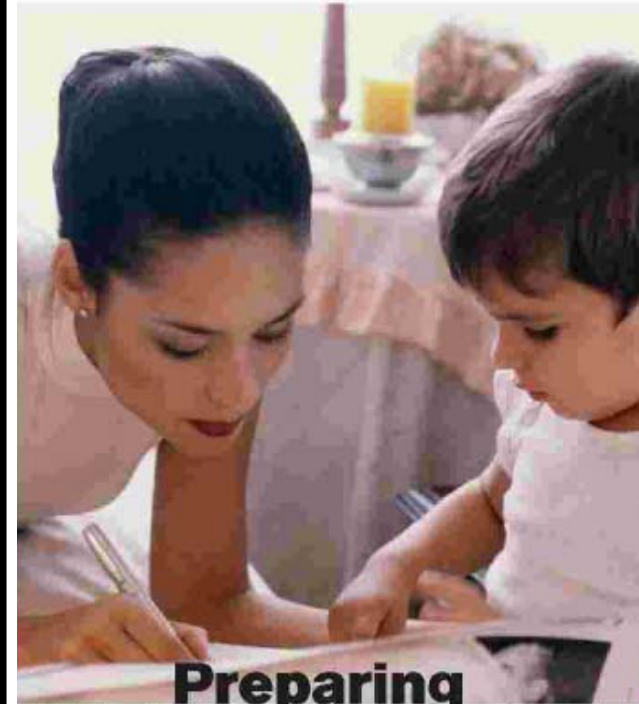
Example: DHS recommendations for household emergency preparation

Recommended Supplies to Include in a Basic Kit:

- Water** one gallon per person per day, for drinking and sanitation
- Food** at least a three-day supply of non-perishable food
- Battery-powered radio** and **extra batteries**
- Flashlight** and **extra batteries**
- First Aid kit**
- Whistle** to signal for help
- Filter mask** or cotton t-shirt, to help filter the air
- Moist towelettes** for sanitation
- Wrench or pliers** to turn off utilities
- Manual can opener** for food (if kit contains canned food)
- Plastic sheeting and duct tape** to shelter-in-place
- Garbage bags and plastic ties** for personal sanitation
- Unique family needs**, such as daily prescription medications, infant formula or diapers, and important family documents

To protect against terrorism-related emergencies, DHS recommends that people stockpile 3 days of food, water, medicine, clothing, bedding, plastic sheeting, & other supplies.

Under what conditions does this make sense?



**Preparing
Makes Sense.
Get Ready
Now.**



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Security**

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Factors that should be considered in deciding whether or not to prepare for sheltering

- Opportunity cost of expenses for time, materials, and space
- Odds that shelter will ever be used
- Number of people in household
- Other uses (e.g., flood, snow emergency)

Costs of following official guidance for 10 years

Component	Initial stocking cost, \$	Annual replacement cost, \$
Potable water in safe container, 1 gallon/person/day	1-30	0-30
Food with long shelf life	25-70	5-70
Radio (AM/FM and NOAA weather) with extra batteries	10-20	2-4
Flashlights and batteries	5-10	2-5
First aid kit and first aid book	30-50	2
Whistle	5	0
Dust mask (one per person)	3	0
Duct tape and plastic sheeting	10-20	0
Personal sanitation/hygiene supplies	6	1
Tools (wrench, pliers)	5	0
Can opener	4	0
Road maps	3	0
Medicines including prescriptions	1-20	1-10
Eyeglasses or contact lenses & cleaning supplies ^a	3	2
Infant formula and diapers	1	1
Pet food	5	0
Copies of important documents	1	1
Cash (\$500) ^b	35	35
Bedding	10-50	0
One change of clothes and shoes per person	10-40	5
Chlorine bleach and medicine dropper	3	2
Fire extinguisher	10-30	0
Paper plates, paper towels, and plastic utensils	5	0
Books, games & entertainment	5-30	0
Space to store materials - 1 m ² @ \$8-15 m ⁻² month ⁻¹	100-180	100-180
Time valued at \$6-20 h ⁻¹	18-60	9-30
Estimated median across all households	465	252
Net present value over 10-y lifetime, 4% discounting, \$		2,400

^aAssumes existing eyeglasses/contacts are used. Costs are for cleaning supplies only.

^bAssumes opportunity cost of cash stashed away is 7% per year.

Example estimate of odds that home fallout preparations will be effectively used

Odds of nuclear attack anywhere in the US within 10 year physical lifetime of shelter = .05

If attack happens in US, it will be in my city = .2

If attack happens in my city, wind will be blowing toward my house = .2

If wind is blowing toward my house, I will be home: 0.3

If I am at home, a timely alert will be issued: 0.5

If alert is timely, I will hear it in time to take shelter: 0.5

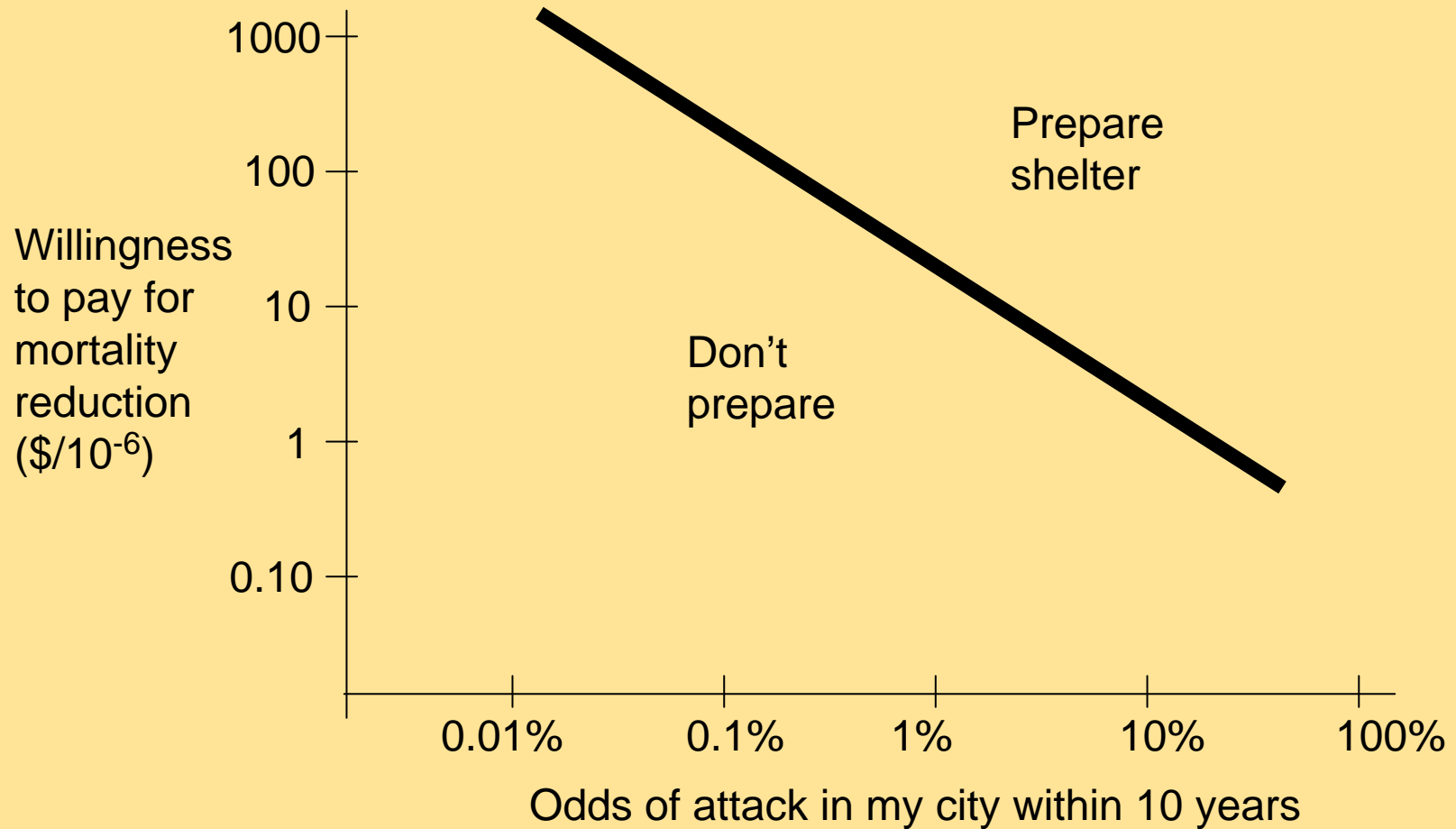
If I hear it, I will decide to shelter rather than flee: 0.5

If I decide to shelter, my shelter will save me: 0.5

Overall odds that shelter will save my life → **4 in 100,000**

Cost-effectiveness: $\$2k/4 \times 10^{-5} \sim$ **\$50 million per life saved**

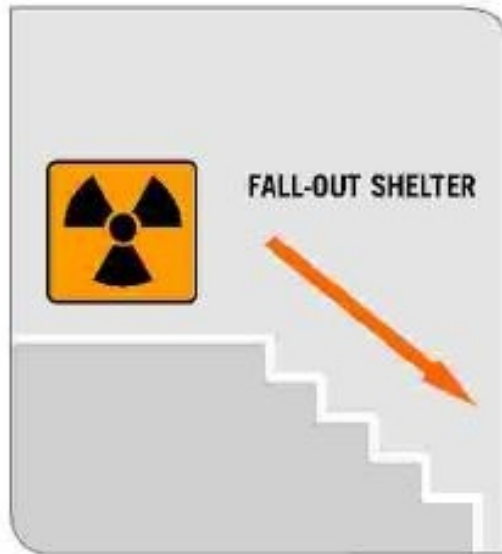
Break-even point for investing in shelter preparation if fallout protection is only use



DHS advice

(http://www.ready.gov/america/_downloads/nuclear.pdf)

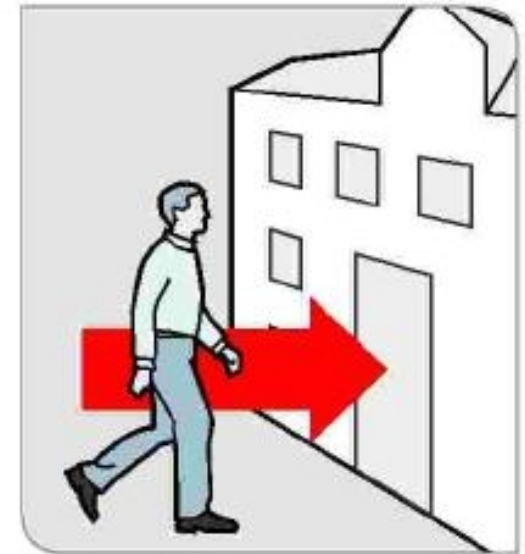
BE INFORMED NUCLEAR BLAST



1. Take cover immediately, below ground if possible, though any shield or shelter will help protect you from the immediate effects of the blast and the pressure wave.



2. Consider if you can get out of the area;



3. Or if it would be better to go inside a building and follow your plan to "shelter-in-place".

More Nuanced Advice

Fallout arrival	Distance from blast	Risk from unsheltered exposure during first hour of fallout	Risk from 90% effective shelter during first hour of fallout	Recommendation
< 15 min.	< 4 km	Acutely fatal for all	Acutely fatal for most	Shelter in deepest space reachable within minutes.
15-60 min.	4- 10 km	Acutely fatal for most. Quadruple cancer risk for the few survivors.	Acutely fatal for some. Doubling of cancer risk for survivors.	Travel only if certain that better shelter can be reached before fallout arrives. Use extra time to fortify shelter space.
30-90 min.	10-20 km	Acutely fatal for some. Doubling of cancer risk for survivors.	20% additional cancer risk.	Travel if risk of exposure to fallout seems worth the benefit. Use extra time to fortify shelter space.
1-3 hours	20-50 km	20% additional cancer risk	2% additional cancer risk	Travel if risk of exposure to fallout seems worth the benefit. Failure to reach shelter before fallout arrives has health consequences that are significant, but not acutely fatal.
> 2 hrs	50-100 km	5% additional cancer risk	< 1% additional cancer risk	Sufficient time exists for travel to get home, collect family members, and/or flee.

Competent Execution Requires

Domain specialists in the processes creating and controlling the risks

Risk and decision analysts, identifying information critical to choices

Behavioral scientists, for designing and evaluating messages

Communication specialists, for disseminating messages and fielding queries

All keeping to their own tasks
(e.g., no physicists doing psychology)

[Fischhoff 2006]

Readings

- M.G. Morgan, B. Fischhoff, A. Bostrom, & C.J. Atman (2002). Risk communication: A mental models approach. New York: Cambridge University Press.
- H.K. Florig, and B. Fischhoff (2007) “Individuals’ Decisions Affecting Radiation Exposure after a Nuclear Explosion,” Health Physics, 92(5):475-483.
- W. Bruine de Bruin, H.K. Florig, B. Fischhoff, Julie S. Downs, and E. Stone, “Understanding Public Responses to Domestic Threats,” Prepared for Defence Research and Development Canada, Report no. DRDC No. CR 2007-111, October 2007.
- Fischhoff, B. (2006, May). Communication: Getting straight talk right. Harvard Business Review, 8.

Thank you

