Integrating Risk Analysis and Risk Communication

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Public Trust Matters

Any government or industry depends on a commons of public goodwill that grows or shrinks, each time that it comes to the public's attention.

Public Trust Has Broad Effects

regulations
litigation
sales
capital markets
executive effectiveness
innovation
employee recruitment and retention
…

REPUTATION, STOCK PRICE, AND YOU

WHY THE MARKET REWARDS SOME COMPANIES AND PUNISHES OTHERS

Dr. Nir Kossovsky

Problems Can Arise Anywhere (nuclear power version)

mining
transportation
construction
power generation
waste disposal
proliferation/national security
jobs/training
medicine
innovation
climate
…

When They Do, Everyone Suffers

The public may not discriminate among segments of the government or industry. As a result, poor performance by any party can threaten the others.

Sound Communication Requires Analytical and Behavioral Research

Analysis. Identify the facts most relevant to the choices that people face.
Description. Learn what they know already.
Intervention. Close the critical gaps.

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Evaluate.
Repeat as necessary.

Nuclear Terrorism

What to say before, during, and after an attack

Florig, K., & Fischhoff, B. (2007). Individuals' decisions affecting radiation exposure after a nuclear event. *Health Physics, 92*, 475-483

The Costs of Following CDC Guidance

Component	Initial stocking cost, $	Annual replacement cost, $
Food with long shelf life	25-70	5-70
Potable water in safe container, 1 gallon/person/day	1-30	0-30
One change of clothes and shoes per person	10-40	5
Paper plates, paper towels, and plastic utensils	5	0
Plastic bags	2	0
Bedding	10-50	0
Battery-operated radio and batteries	10-20	2-4
Medicines	5-40	3-20
Toiletries	5	0
Flashlights and batteries	5-10	2-5
Telephone or cell phone (use existing phone)	0	0
Extra eyeglasses or contact lenses and cleaning supplies*	3	2
Duct tape and heavy plastic sheeting	10-20	0
Pet food, baby formula, diapers, etc.	5	3
First aid kit	20-40	2
Games & entertainment	5-30	0
Space to store materials - 1 m^2 @ \$10-20/m^2/month	100-180	100-180
Time - \$6-20 per hour	18-60	9-30
Estimated average across all households	380	200
Average 10-year cost per household, 4% discounting	\$1,900	

*Assumes existing eyeglasses/contacts are used. Costs are for cleaning supplies only.

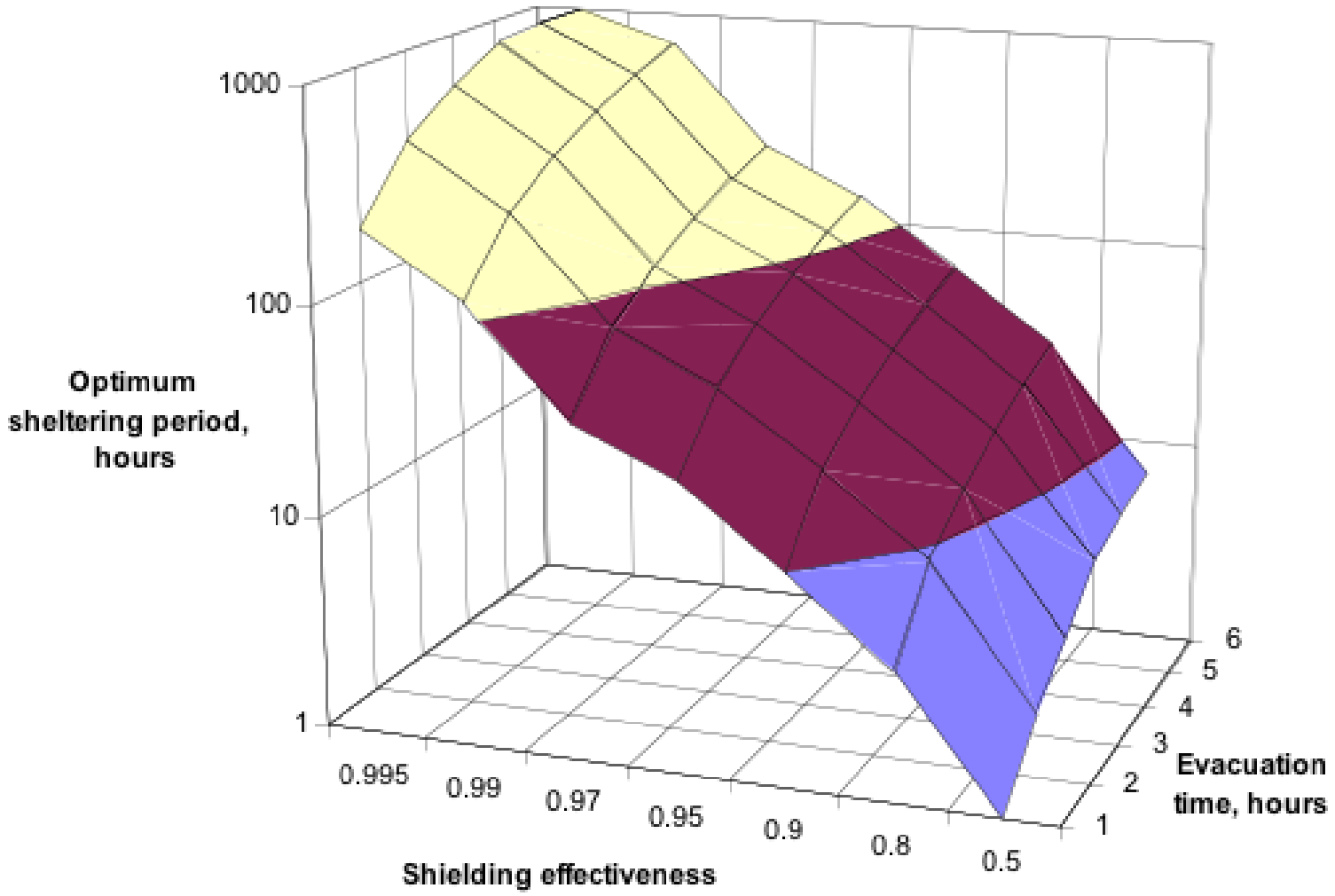
Probability of Shelter Usefulness

Event	Possible probability
Probability of an attack in US over shelter's lifetime	0.05
If attack happens in US, it is in their city	0.1
If attack happens in their city, wind blows toward their house	0.2
If wind blows toward their house, n = 1,2,3, or 4 people close to home	0.1, 0.2, 0.3, 0.4
If n people are at home, sheltering alert issued	0.5
If sheltering alert is issued, they hear it in time	0.5
If they hear alert, they decide to shelter	0.5
If they decide to shelter, their shelter is adequate	0.5
Probability that shelter services 1, 2, 3, or 4 people	**.000013, .000025, .000025, .00005**

Rules for Immediate Response

Distance from blast	Fallout arrival	Risk from 3 hr. exposure	Recommendation
< 4 km	< 10 min.	Soon fatal	Shelter immediately.
4- 20 km	10-60 min.	Soon fatal to 50% of exposed. High cancer risk for survivors.	Travel only if certain that better shelter can be reached before fallout arrives. Use time to prepare
20-50 km	1-2 hours	2-20% additional cancer risk	Travel only if exposure risk small or benefit large. Use time to prepare.
50-100 km	> 2 hrs	0.5-2% additional cancer risk	Flee if fallout direction is known. Go home or collect family members. Otherwise, remain indoors.

Rules for Evacuation



Adolescent Sexual Health

What to say to young women in order to improve their lives

Downs, J. S., Murray, P. J., Bruine de Bruin, W., White, J. P., Palmgren, C., & Fischhoff, B. (2004). An interactive video program to reduce adolescent females' STD risk: A randomized controlled trial. *Social Science and Medicine, 59*, 1561-1572

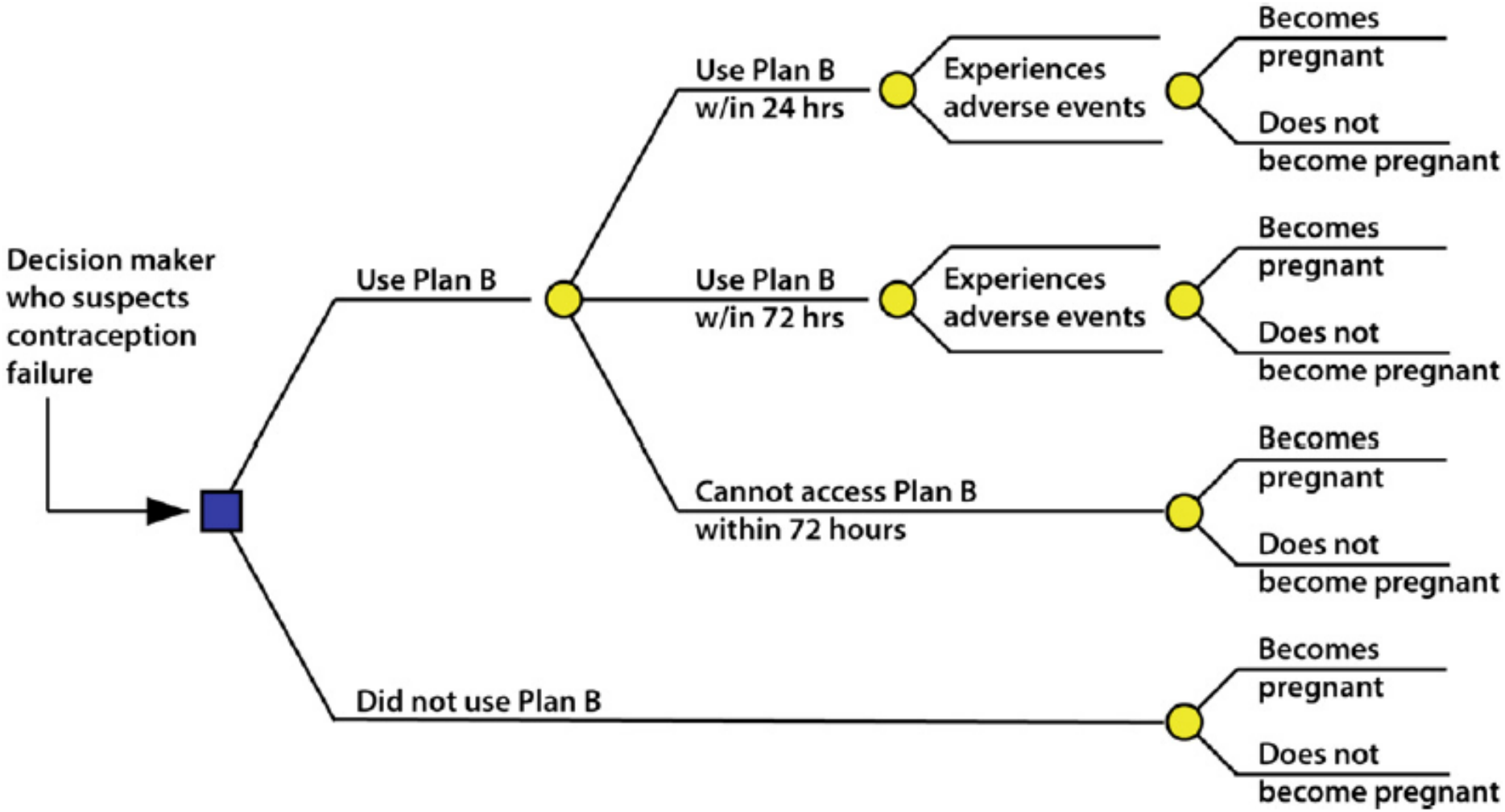


Fig. 1. Decision tree for emergency contraception use, conditional on suspecting failure of primary contraceptive method.

Informing Decisions

Creating Decision Options

Evaluation

Compared to "usual care," young women in DVD condition

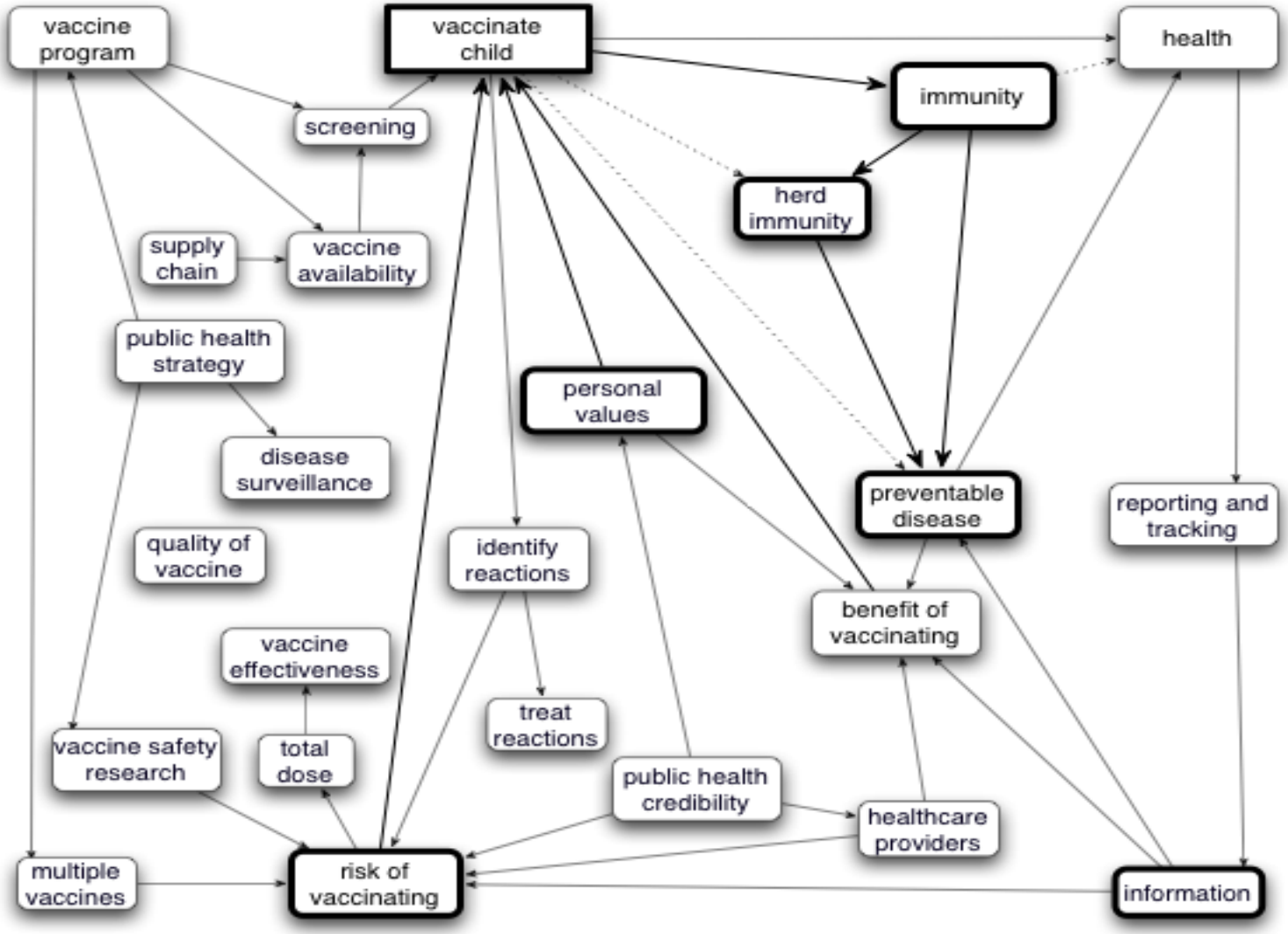
More than twice as likely to become abstinent
Half as many reported condom failures
45% less likely to report an STI
Less likely to test positive for Chlamydia

Measles Mumps Rubella Vaccine

What to say to those who are skeptical about the costs or benefits

Downs, J. S., Bruine de Bruin, W., & Fischhoff, B. (2008). Patients' vaccination comprehension and decisions, *Vaccine, 26*, 1595-1607

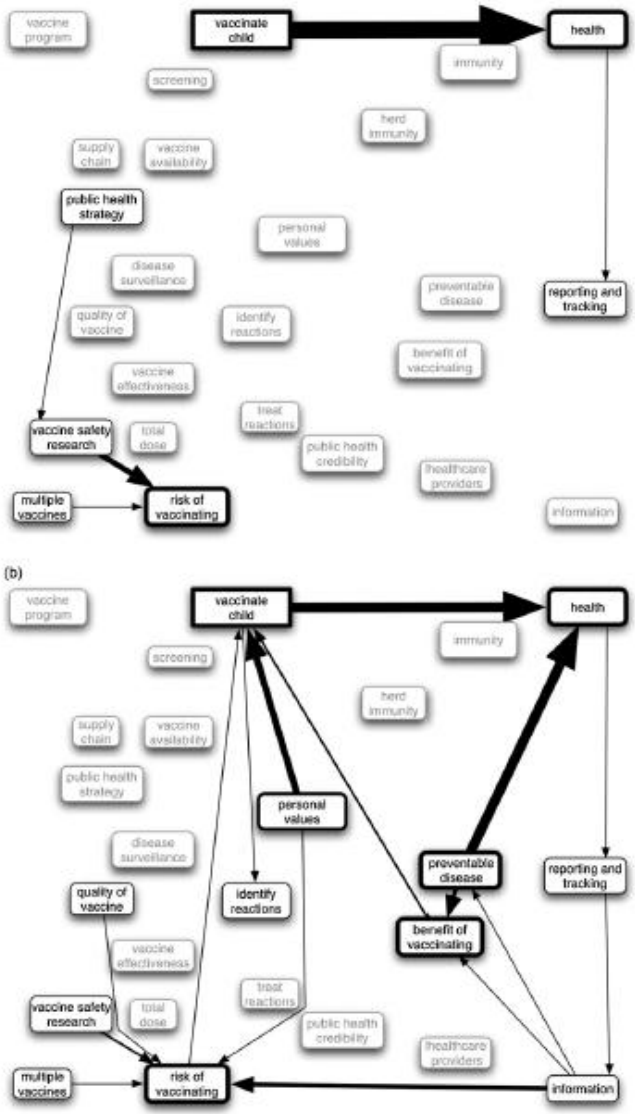
Factors Determining Vaccine Outcomes



Factors Mentioned in Communications

by proponents

by skeptics



Personal Safety (preventing sexual assault)

Analysis: meta-analysis of effectiveness studies

Description: nuanced belief structure, differing goals, exaggerated effectiveness

Intervention: realistic expectations, societal responsibility, effectiveness research

Fischhoff, B. (1992). Giving advice: Decision theory perspectives on sexual assault. *American Psychologist, 47*, 577-588.

Worker Safety (methylene chloride solvent)

Analysis: diffusion-uptake model, predicting cumulative dose and peak levels

Description: users willing to act, but confused over method effectiveness

Intervention: voluntary control perhaps impossible, without mandatory label design

Riley, D.M., Fischhoff, B., Small, M., & Fischbeck, P. (2001). Evaluating the effectiveness of risk-reduction strategies for consumer chemical products. *Risk Analysis, 21*, 357-369

Emergency Warning (water system contamination)

Analysis: model of system performance, including detection, coordination, and consumer behavior

Description: little knowledge in affected communities, useless knowledge among vulnerable individuals

Intervention: abandon warning system, provide services for vulnerable

Casman, E., Fischhoff, B., Palmgren, C., Small, M., & Wu, F. (2000). Integrated risk model of a drinking waterborne Cryptosporidiosis outbreak. *Risk Analysis, 20*, 493-509

Some Other Applications

plague
perchloroethylene
LNG
climate change
detergent
breast cancer
nuclear explosions
herpes (stigma)
xenotransplantation
smart meters
…

domestic radon
breast implants
EMF
UXO
violent radicalization
bioterrorism
nuclear power in space
Plan B (morning-after pill)
neonates
vaccines (anthrax)
…

Skills Needed

Domain experts
Risk analysts
Risk communicators

Skills Needed

Domain experts
Risk analysts
Risk communicators
Senior leadership

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regulations
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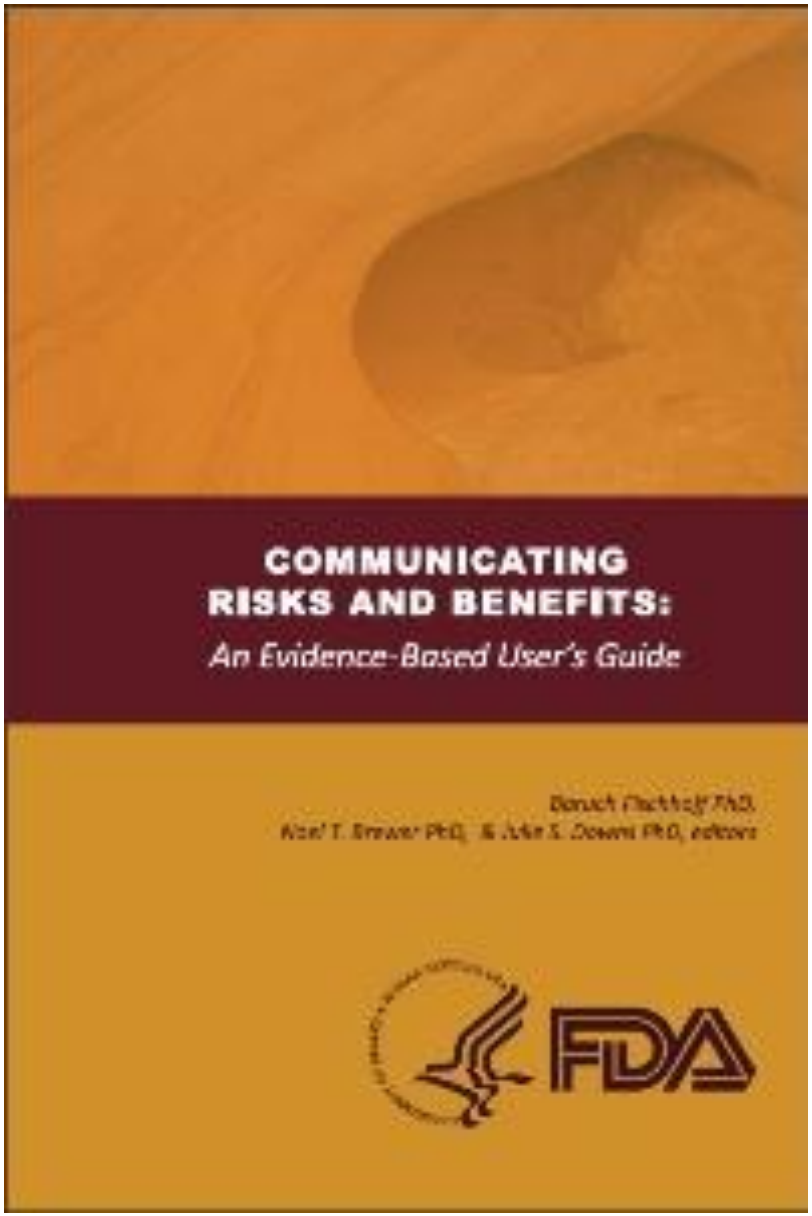
FDA'S
STRATEGIC PLAN
FOR
RISK COMMUNICATION

Fall, 2009

Recommendations for Managing Emerging Events

Have a consistent policy in all domains
Provide useful, timely information
Address: risks and benefits, uncertainty, personal actions, FDA actions
Audience needs should drive agency analyses
Use standard formats; evaluate routinely
Consider needs of diverse populations

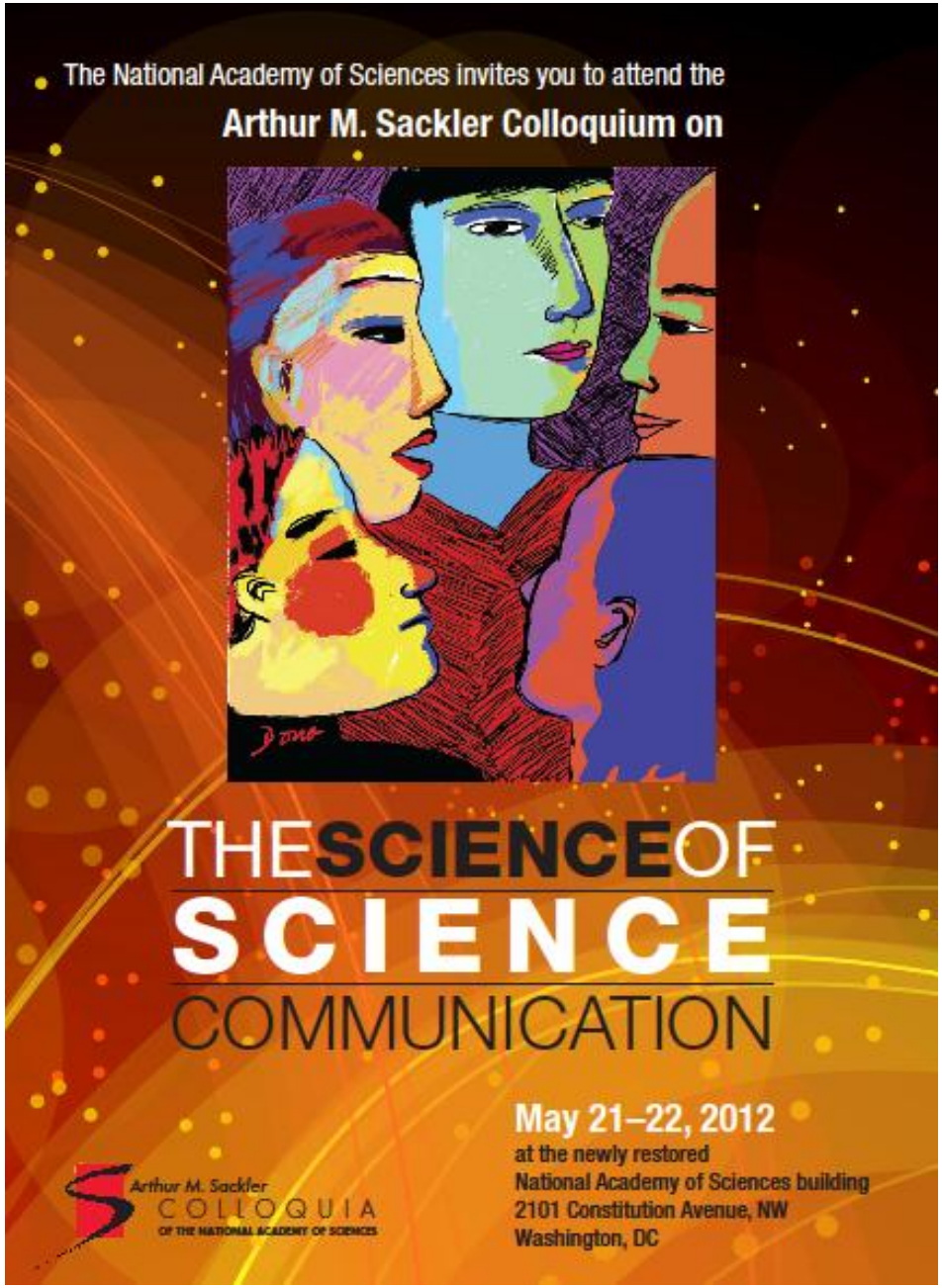
http://www.fda.gov/oc/advisory/OCRCACACpg.html



http://www.fda.gov/AboutFDA/ReportsManualsForms/Reports/ucm268078.htm

FDA Pharmaceutical Approval Decisions

Decision Factor	Evidence and Uncertainties	Conclusions and Reasons
Analysis of Condition	Summary of evidence:	Conclusions (implications for decision):
Unmet Medical Need	Summary of evidence:	Conclusions (implications for decision):
Clinical Benefit	Summary of evidence:	Conclusions (implications for decision):
Risk	Summary of evidence:	Conclusions (implications for decision):
Risk Management	Summary of evidence:	Conclusions (implications for decision):



http://www.nasonline.org/programs/sackler-colloquia/completed_colloquia/science-communication.html

Communication Resource Centers

Provide publication-quality scientific support for designing, implementing, and empirically evaluating solutions.

Communication Resource Centers

Provide publication-quality scientific support for designing, implementing, and empirically evaluating solutions.

-- quality assurance
-- economies of scope
-- pool lessons learned
-- anticipate problems
-- involve academic researchers

Books

Fischhoff, B., Brewer, N., & Downs, J.S. (eds.). (2011). *Communicating risks and benefits: An evidence-based user's guide*. Washington, DC: Food and Drug Administration. http://www.fda.gov/AboutFDA/ReportsManualsForms/Reports/ucm268078.htm

Fischhoff, B., & Chauvin, C. (eds.). (2011). *Intelligence analysis: Behavioral and social science foundations*. Washington, DC: National Academy Presshttp://www.nap.edu/catalog.php?record_id=13062

Fischhoff, B., & Kadvany, J. (2011). *Risk: A very short introduction*. Oxford: Oxford University Press.

Fischhoff, B., Lichtenstein, S., Slovic, P., Derby, S. L. & Keeney, R. L. (1981). *Acceptable risk*. New York: Cambridge University Press. (NUREG/CR-1614).

Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar Giroux & Strauss.

Morgan, M.G., Henrion, M. (1990). *Uncertainty*. New York: Cambridge University Press.

Slovic, P. (ed.) (2000). *Perception of risk*. London: Earthscan.

Research Articles

Bruine de Bruin, W., Parker, A., & Fischhoff, B. (2007) Individual differences in adult decision-making competence (A-DMC). *Journal of Personality and Social Psychology. 92*, 938-956.

Fischhoff, B. (1992). Giving advice: Decision theory perspectives on sexual assault. *American Psychologist*, 47, 577-588.

Fischhoff, B. (2011). Communicating the risks of terrorism (and anything else). *American Psychologist, 66*, 520-531.

Fischhoff, B. (2012, Summer). Communicating uncertainty: Fulfilling the duty to inform. *Issues in Science and Technology*, *29*, 63-70 ,

Fischhoff, B., Bruine de Bruin, W., Guvenc, U., Caruso, D., & Brilliant, L. (2006). Analyzing disaster risks and plans: An avian flu example. *Journal of Risk and Uncertainty*, 33, 133-151.

http://www.hss.cmu.edu/departments/sds/src/faculty/fischhoff.php

Carnegie Mellon Electricity Center: http://wpweb2.tepper.cmu.edu/ceic/

Center for Climate and Environmental Decision Making: http://cedm.epp.cmu.edu/index.php

Center for Risk Perception and Communication: http://sds.hss.cmu.edu/risk/

Center for Human Rights Science: http://www.cmu.edu/chrs/