
Developing good habits for public protection

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Evidence suggests a change in radiation protection

Be Cautious with the
Precautionary Principle:
Evidence from Fukushima
Daiichi Nuclear Accident

APRIL 29, 2020 • RESEARCH BRIEFS IN ECONOMIC POLICY NO. 212

By Matthew J. Neidell, Shinsuke Uchida, and Marcella Veronesi

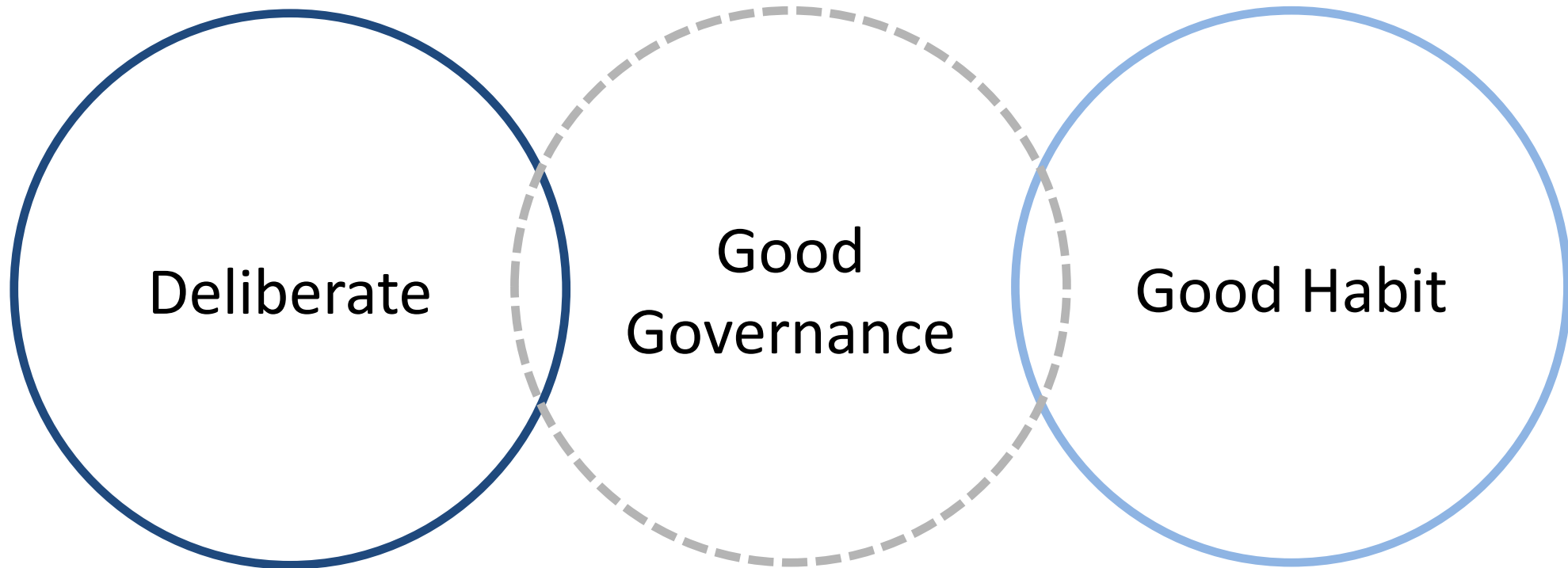
**Saving Lives and Preventing Injuries From
Unjustified Protective Actions—Method for
Developing a Comprehensive Public Protective
Action Strategy for a Severe NPP Emergency**

J Callen, T McKenna

**Fukushima's
Evacuation May Have
Done More Harm Than
Good**

By Philip Thomas
November 21, 2017

But how do we change?



We rely on habit in times of uncertainty

Crisis and Emergency Risk Communication (HHS, 2014)

Crises, by definition, create very high levels of uncertainty....During crisis situations, decision makers are often unable to collect and process information in a timely manner. They rely on established routines for situations that are, by definition, not routine.



*Rather than emergency bringing about the end of thinking,
thinking should bring about the end of emergency.*

—Elain Scarry, Thinking in an Emergency

Protective actions should do more benefit than harm

Stressors can disrupt the balance between protection and harm

The World Health Organization identified three such stressors:

- Stressor 1 – Radiation
- Stressor 2 – Protective Actions
- Stressor 3 – Stigmatization

How can good habits help protect the public?

Stressor 1: Radiation

Which communication habit is useful?

Habit 1: Radiation is invisible, its effects are uncertain, and the public fears it.

Habit 2: Radiation is detectable, predictable, protectable.

What we know and what the public understands

Radiation Risks in Perspective (2006)

We know more about the health effects of ionizing radiation than most other carcinogenic agents.

Strengths of Public Messages (U.S. CDC, 2012):

Participants felt another key message was that low exposures of radiation may result in minimal or no health effects.

- *Exposure to the radiation can be harmful.*
- *I guess that not all radiation is bad, depending on the dose.*

Mossman, Kenneth. *Radiation Risks in Perspective*, CRC Press, 2006.

U.S. Centers for Disease Control and Prevention (U.S. CDC). "Health Effects Message Testing: Detonation of Improvised Nuclear Device," Oak Ridge Institute for Science and Education (ORISE) and National Center for Environmental Health, Radiation Studies Branch, January 2012.

Develop habits of communicating what is known

Communicating During and After a Nuclear Power Plant Incident (2013)

How much radiation is safe?

According to radiation safety experts, radiation exposure between 5–10 rem (50-100 mSv) usually results in little to no harmful health effects.

It takes a large dose of radiation—more than 75 rem (750 mSv)—in a short amount of time (usually minutes) to cause immediate health effects like acute radiation sickness.

Stressor 2: Protective Actions

Which response habit is useful?

Habit 1: Immediate evacuation out of an abundance of caution.

Habit 2: Go inside, stay inside, tune in.

Lessons from All-Hazards Risk Communication

Crisis and Emergency Risk Communication (U.S. HHS/CDC, 2014)

Give decision makers and others with influence in the community open access to complete scientific information.

Risk Communication Strategies for the Very Worst of Cases (Johns Hopkins, 2019)

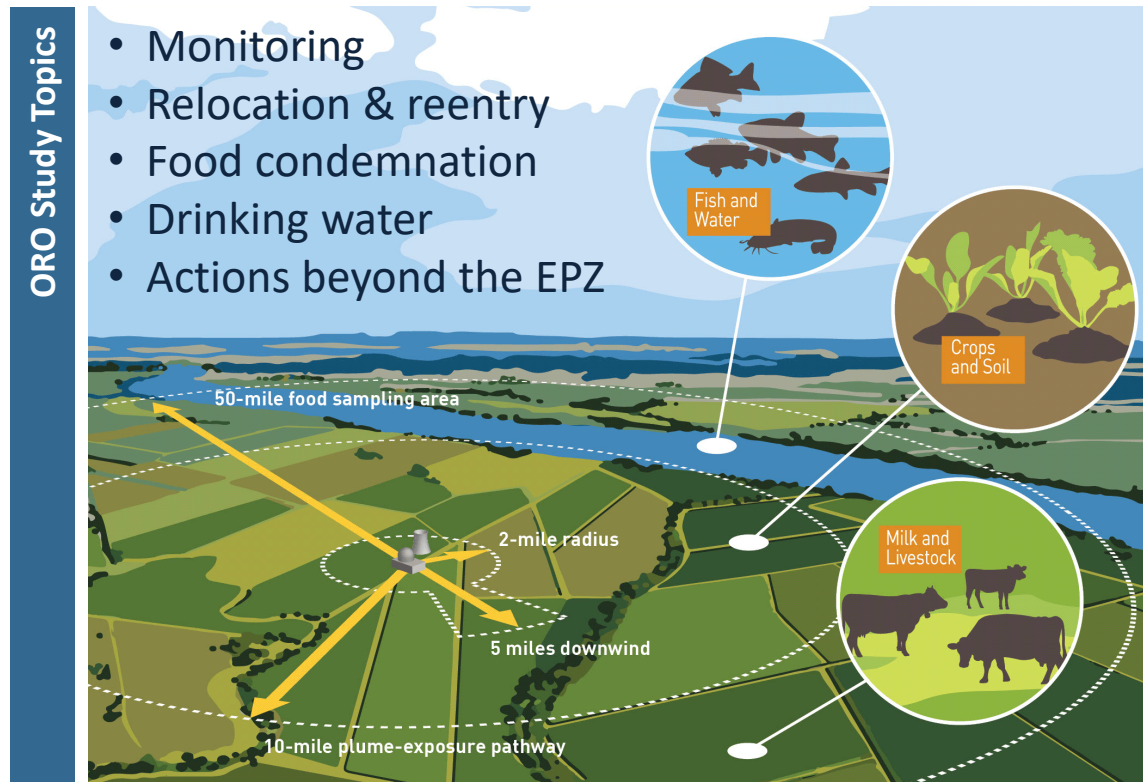
“Our elected officials...don’t really talk about these issues with any degree of urgency... Improving or increasing the knowledge of key leaders and decision makers will help.”

The NRC supports public protection with evidence

- Protective Action Decision-Making in the Intermediate Phase (NUREG/CR-7248)
- Evacuation Time Estimate Study (NUREG/CR-7269)
- Emergency Planning Zone (EPZ) Size Methodology
- Sensitivity of Dose Projections to Weather
- Analysis of the Effectiveness of Sheltering-in-Place
- Use of Heating and Ventilation Systems during Sheltering-in-Place
- Dose Reduction Effectiveness of Masks
- Nonradiological Health Impacts of Evacuations and Relocations (NUREG/CR-7285)
- MACCS Consequence Model Improvements to Inform Protective Action Recommendations

Gathering and sharing best practices

Shared understanding of offsite response organization (ORO) capabilities and practices for protecting the public in the transition phase

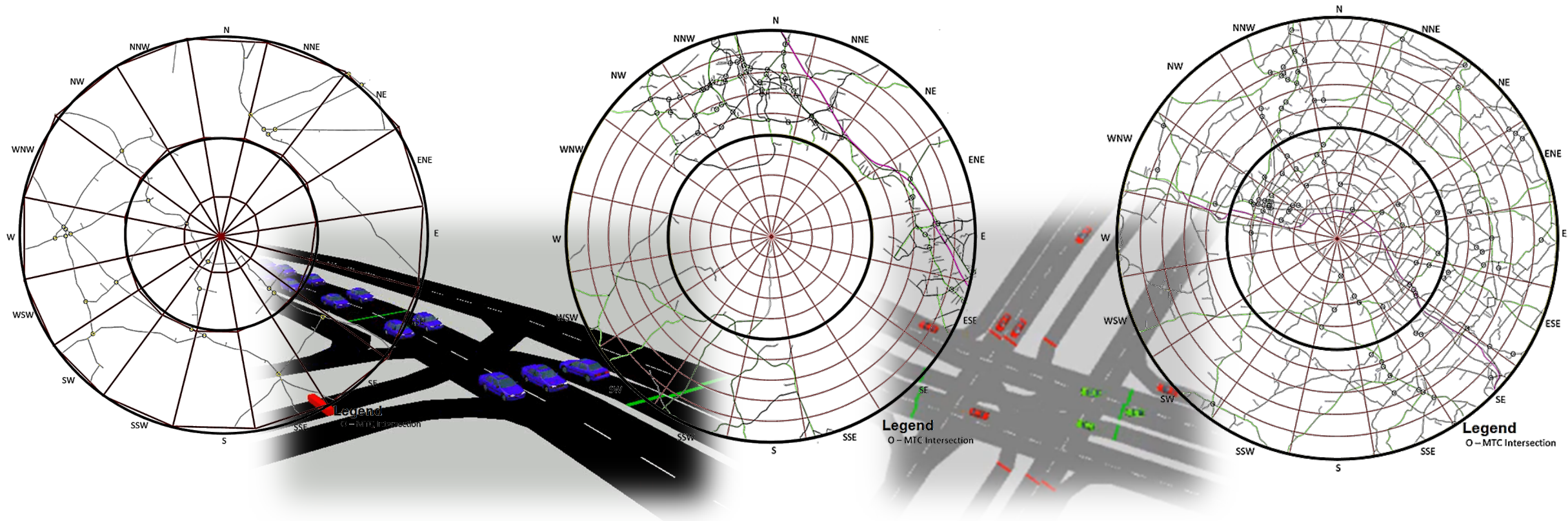


Best Practices identified for:

- Communicating with the public
- Developing partnerships and sharing resources for monitoring
- Situation-dependent decisions based on science
- Leveraging technology
- Vulnerable populations, livestock and pets

Providing insights into effective evacuation

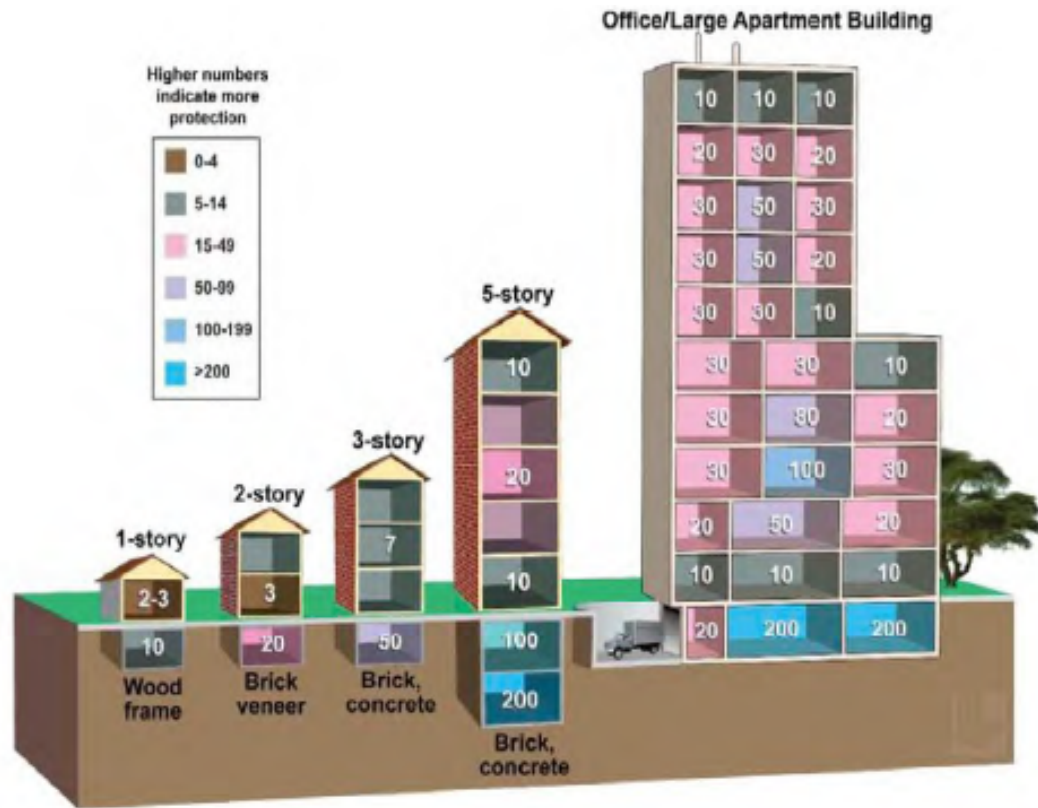
State-of-the-art traffic simulation models used to better understand evacuation dynamics and to develop insights for protecting the public and first responders.



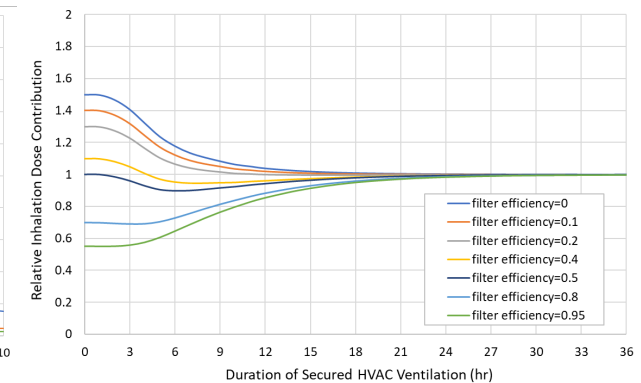
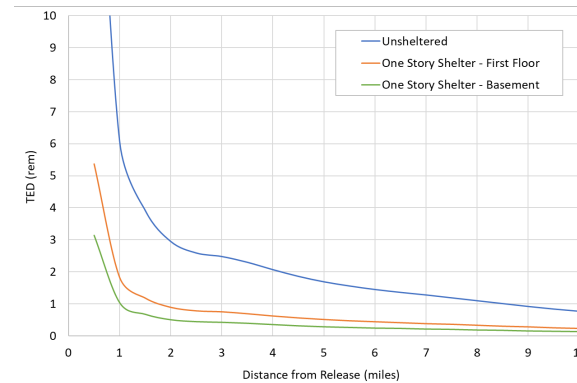
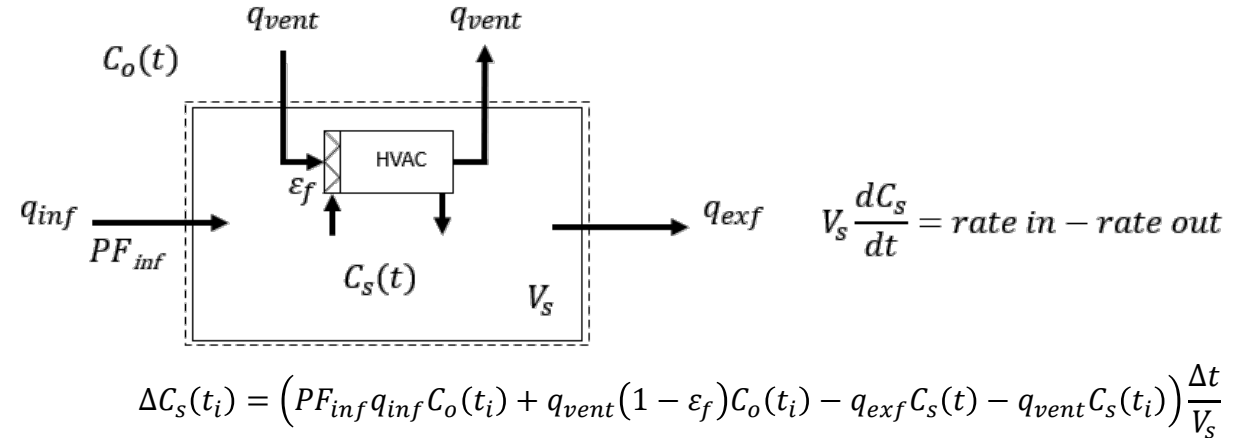
U.S. NRC. NUREG/CR-7269, "Enhancing Guidance for Evacuation Time Estimate Studies," January 2020.

<https://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr7269/index.html>

Analyzing the protection of shelters



Dose Reduction Factors
(U.S. EPA, 2017)



Effectiveness of sheltering-in-place
(Smith, 2021)

U.S. EPA. EPA-400/R-17/001, "PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents," Office of Radiation and Indoor Air, January 2017.
 Smith, Todd R. *Transforming Protective Action Strategies for Radiological Emergencies—Exactng the Science of Sheltering-in-place*. Oregon State University, 2021.

Quantifying the benefits of masks



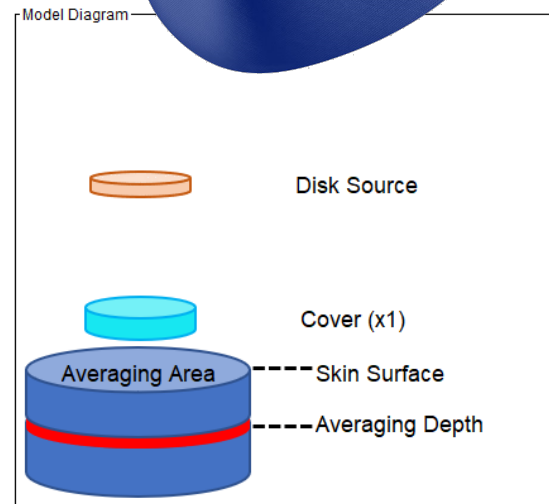
RASCAL

Radiological Assessment System for Consequence Analysis for radiological emergencies

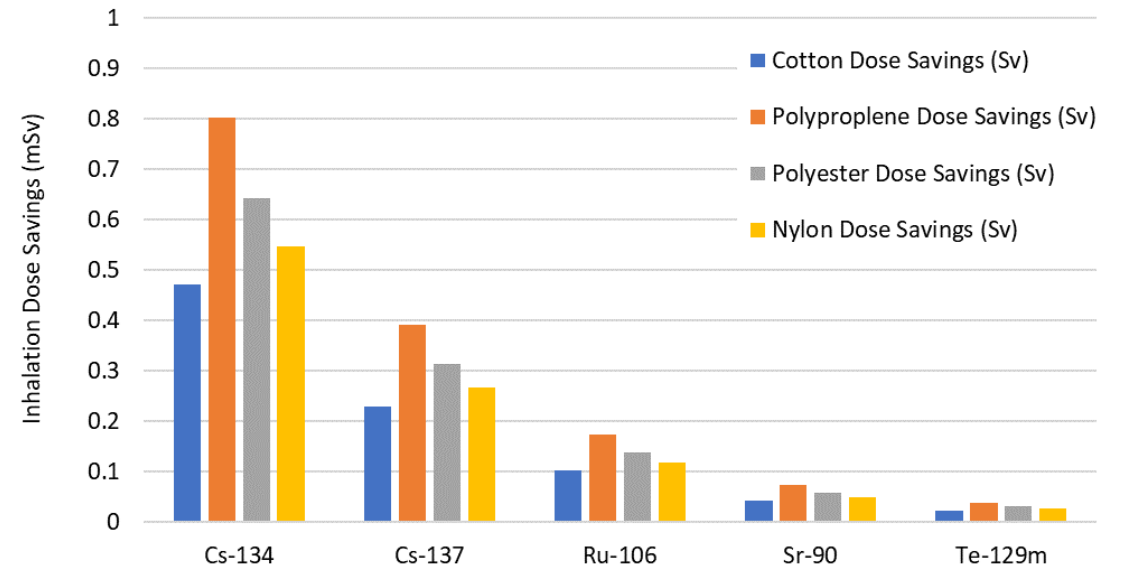


VARSKIN

Dose calculation for skin contamination



Inhalation Dose Savings for Various Nuclides and Mask Materials



RAMP Website

Radiation Protection Computer Code Analysis and Maintenance Program

<https://ramp.nrc-gateway.gov/>

Because the public wants to know how to be safe

Health Effects Message Testing (U.S. CDC, 2012)

Feedback on Public Messages:

Although participants understood the main messages, they expressed that the information they would want to hear during an emergency came too late in the message. If there was any good message, it was one that you're best off being inside and I really don't remember exactly, but let's say go in a cellar or someplace that's secure.

- The first part of it reminds me of just going back to very informational, and the second part reminds me more of what you would do for an emergency.*
- I marked out the first two sections. Just give me the rest down at the bottom.*
- Just give them the information to keep themselves safe, what to do until further notice.*

Develop protection habits supported by science

Clear, concise instruction
on how to be safe,
supported by evidence

WHERE TO GO IN A RADIATION EMERGENCY

If a radiation emergency happens in your area, you should get inside immediately. No matter where you are, the safest action to take is to: GET INSIDE. STAY INSIDE. STAY TUNED.

- Close and lock all windows and doors.
- Go to the basement or the middle of the building. Radioactive material settles on the outside of buildings; so the best thing to do is stay as far away from the walls and roof of the building as you can.
- If possible, turn off fans, air conditioners, and forced-air heating units that bring air in from the outside. Close fireplace dampers.
- Bring pets inside.
- Stay tuned for updated instructions from emergency response officials.

GET INSIDE
STAY INSIDE
STAY TUNED

NOT SAFE
OK SAFER
SAFEST

Adapted from Ventura County Public Health, Ventura County, CA

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
<http://emergency.cdc.gov/radiation>

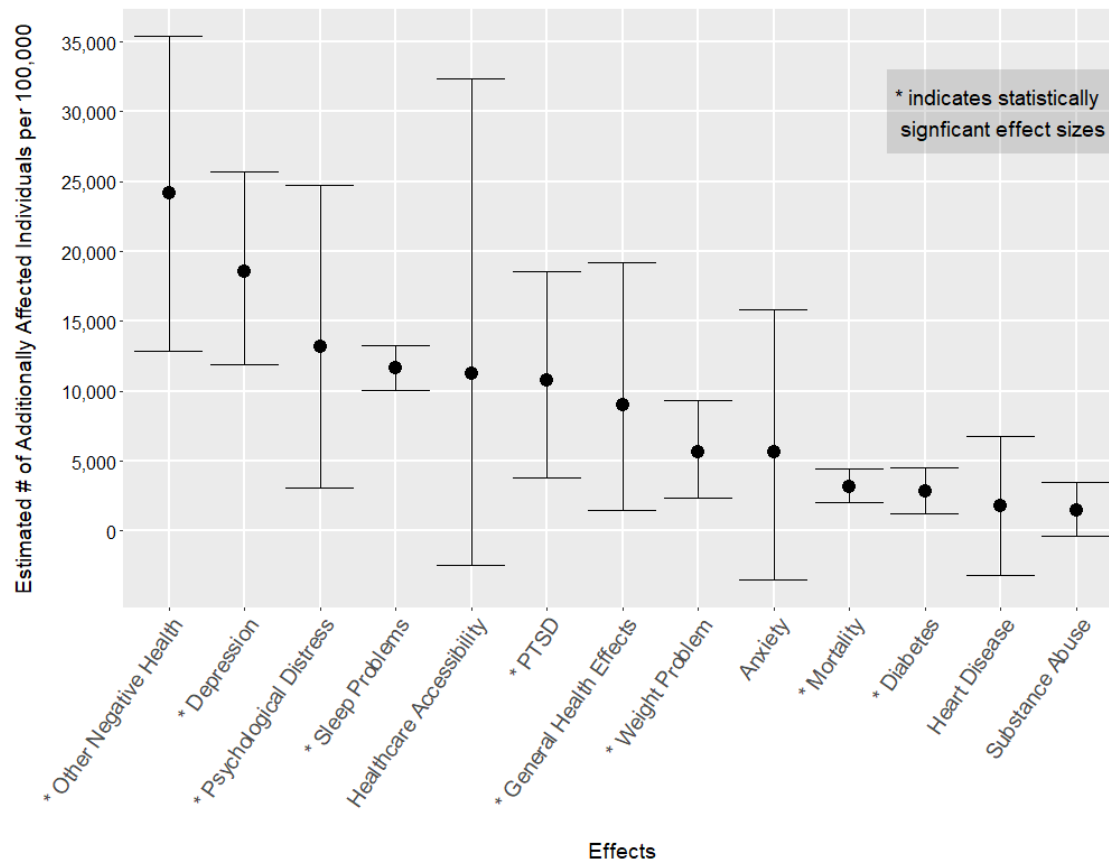
Stressor 3: Stigmatization

Which habit is useful?

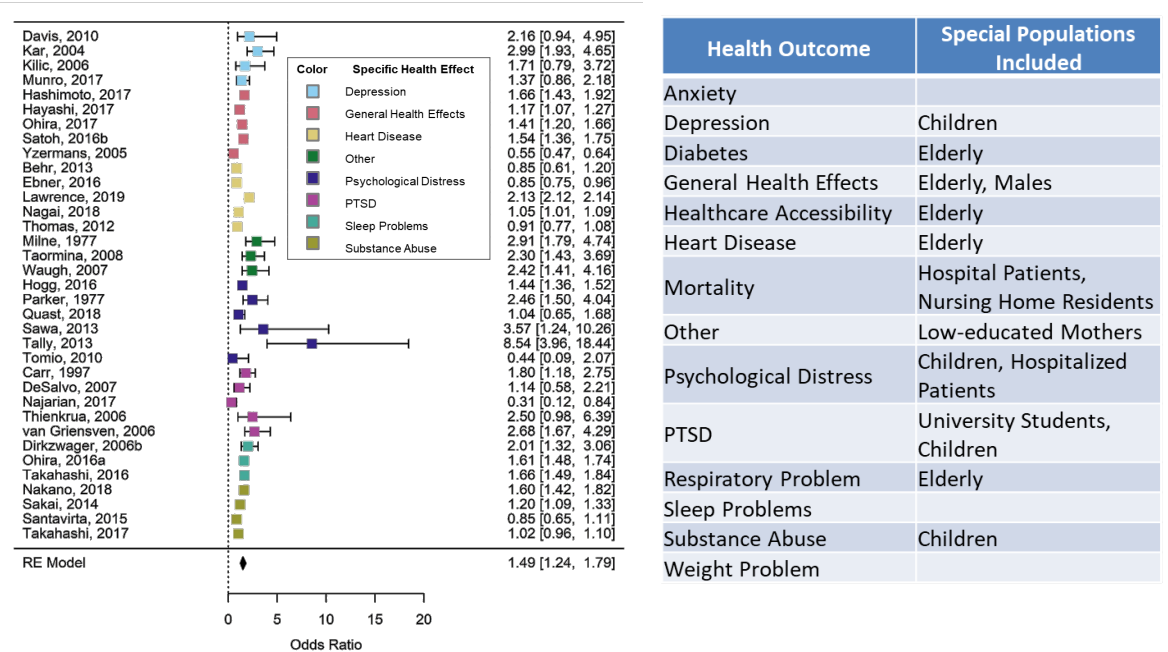
Habit 1: Unique response to radiological emergencies and prolonged displacement from home.

Habit 2: Develop resilient communities able to face all hazards.

Prolonged displacement has quantifiable effects



Meta-analysis of Odds Ratio for All Health Effects



Health Outcome	Special Populations Included
Anxiety	
Depression	Children
Diabetes	Elderly
General Health Effects	Elderly, Males
Healthcare Accessibility	Elderly
Heart Disease	Elderly
Mortality	Hospital Patients, Nursing Home Residents
Other	Low-educated Mothers
Psychological Distress	Children, Hospitalized Patients
PTSD	University Students, Children
Respiratory Problem	Elderly
Sleep Problems	
Substance Abuse	Children
Weight Problem	

Displaced populations are more at risk across all hazards and all health effects

Use the same habits for all hazards

A unique hazard does not require a unique response

Shelter-in-Place for Multistory Buildings

Includes condos, apartments, offices, and schools

Active Shooter
Run, Hide, Fight.
What to do: **Run** away from shooter. Call 911 if safe to do so. **Hide** if you cannot get away safely. Silence electronic devices. Lock and block doors, close blinds, turn off lights. **Fight** as a last resort.
How long to stay: If you are not able to run to safety, stay in place until law enforcement gives you notice that the danger is over.

Hurricane (High Wind, Flooding, Storm Surge)
Shelter-in-Place: Go to a sturdy building. For high wind go to a windowless room on the lowest level. For flooding go as high as possible but not into the attic.
What to do: For high wind, go to a small, interior, windowless room in the lowest level.
How long to stay: Stay inside until local authorities provide other instructions.

Thunderstorm
Shelter-in-Place: Stay inside.
What to do: Pay attention to weather reports. Be ready to change plans if necessary. Unplug appliances, avoid using running water or landline phones.
How long to stay: For the length of the storm.

Winter Storm
Shelter-in-Place: Stay inside. Limit time outside.
What to do: Avoid carbon monoxide poisoning by using generators and grills **ONLY** outdoors, 20 feet from the house and away from windows. Never heat a building with a gas stove top or oven.
How long to stay: For the length of the storm.

Pandemic
Shelter-in-Place: Stay Home. Minimize access to your home from anyone not isolating with you.
What to do: **Reduce trips** outside to only essential requirements. Clean surfaces often with disinfectant. Wash hands for 20 seconds frequently with soap. Avoid touching your eyes, nose, or mouth. **Gather supplies** in case you need to stay home for several days or weeks. If you must go to an office, campus, or live in a multi-story building, make sure to wear a mask and keep a physical distance of at least 6 ft apart.
How long to stay: As advised by local public health officials.

Chemical Hazard
Shelter-in-Place: Stay inside your home and seal the room. Use duct tape around the windows and doors to make an unbroken seal. Tape over vents and electrical outlets.
What to do: **Lock** all doors and windows. **Drink stored water**, not water from the tap. **Turn off** the air conditioner, heater, and fans. **Close** the fireplace damper and seal off any other place where air may come in from outside.
How long to stay: A shelter in place will last approximately 12 hours or less, rarely will it go longer.

Flooding
Shelter-in-Place: Go to the highest level in the building but not in the attic. If the floodwaters rise to a dangerous level, get on the roof and call 911.
What to do: Listen for current emergency information and instructions. Use a generator or other gasoline-powered machinery **ONLY** outdoors and away from windows.
How long to stay: Stay inside until authorities indicate it is safe to leave.

Flash Flooding
Shelter-in-Place: Go to the highest level in the building but not in the attic. If the floodwaters rise to a dangerous level, get on the roof and call 911.
What to do: Listen for current emergency information and instructions. Use a generator or other gasoline-powered machinery **ONLY** outdoors and away from windows.
How long to stay: Stay inside until authorities indicate it is safe to leave.

Earthquake
Shelter-in-Place: Stay where you are and take cover. Get under and old on to sturdy furniture until the shaking stops. Protect the head and neck with arms.
What to do: **Drop, Cover and Hold On**: If in a bed, turn onto stomach and cover your head and neck with a pillow.
How long to stay: For the length of the earthquake.

Nuclear/Radiological
Shelter-in-Place: Go to the basement or middle of the building. Stay away from the outer walls and roof. Take shelter in the basement, underground parking garage, or other lowest level in the structure.
What to do: Remove contaminated clothing and wipe off or wash unprotected skin if you were outside after the fallout arrived.
How long to stay: Stay inside for 24 hours unless local authorities provide other instructions.

Tornado
Shelter-in-Place: Go to basement or lowest level in the structure. Go to a small, interior, windowless room in a sturdy building on the lowest level.
What to do: **Protect** your head and neck. **Take additional cover** by putting blankets around you.
How long to stay: Stay inside until weather forecasts and local authorities say it is safe to do so. Use extreme care when leaving a building as there may be dangerous debris.

FEMA

Visit <https://community.fema.gov/ProtectiveActions/s/> for more information.

Communicate balanced views of the risk

Protective Action Questions & Answers for Radiological and Nuclear Emergencies (U.S. EPA, 2017)

How much radiation is safe? How much is considered low risk?

It takes a large dose of radiation—more than 75 rem (75,000 mrem or 750 mSv)—in a short amount of time (usually minutes to hours) to cause immediate health effects, such as acute radiation sickness.

Infants, the elderly and pregnant women are more sensitive to radiation exposure than healthy adults.

Factors like age, gender and even previous exposure also might influence a body's reaction to radiation exposure.

Follow these three steps to limit your exposure to radiation and lower your risk:

1. Get inside a building or to a basement to protect yourself.

2. Carefully remove the outer layer of your clothing, seal it in a plastic bag and get clean (shower or wipe off).

3. Listen to officials and emergency responders for further safety instructions.

Change is possible

Through deliberation, good governance, and good habit, we can keep the public safe.

What will not change

The U.S. NRC's commitment to protect public health and safety will not change.