Centers for Disease Control and Prevention

Public Health Actions to Prepare for an Effective Radiological/Nuclear Response

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Office of Public Health Preparedness and Response and National Center for Environmental Health Webinar

Thursday, August 24, 2017

AGENDA

- Welcome and Opening Remarks
- CDC Activities and Gotham Shield 2017 Functional Exercise
- Public Health Response to Radiological/Nuclear Emergencies
- Medical Countermeasures in a Radiological/Nuclear Emergency
- Communications in a Radiological Nuclear Emergency
- CDC Next Steps
- Question-and-Answer Session
- Closing Remarks

Opening Remarks

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Gotham Shield Overview and Relevance to Today's Discussion

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GOTHAM SHIELD 2017

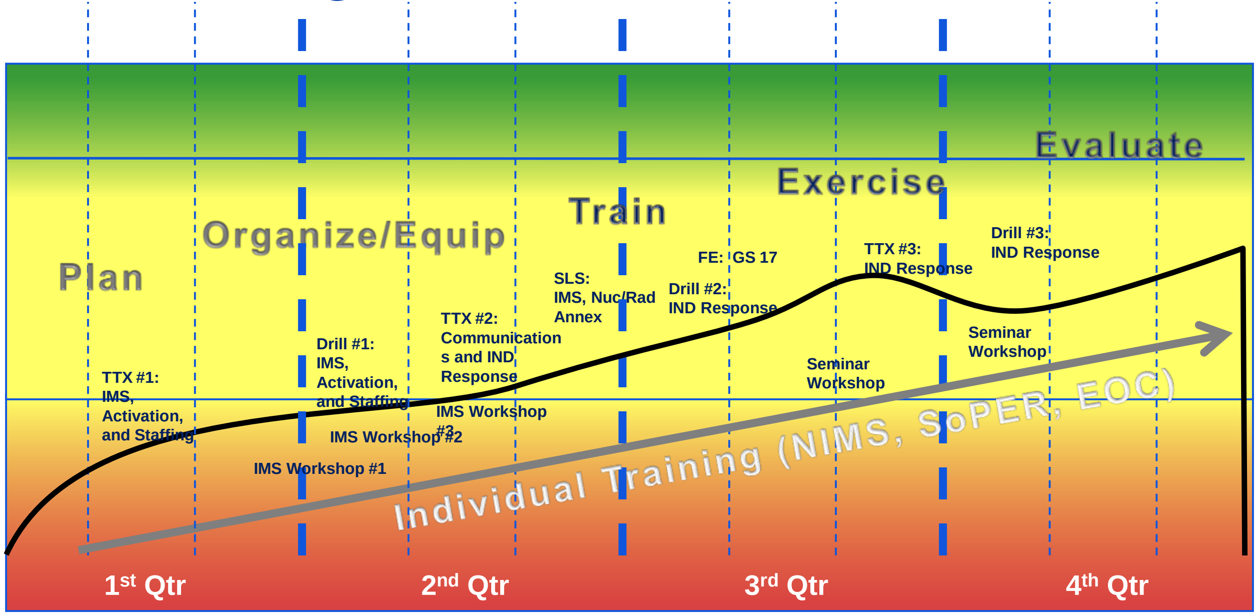
- FEMA-sponsored functional exercise that examined local, regional, and national capabilities across the prevent, protect, response, and recovery mission areas

- Designed to educate and prepare the “whole community” for an act of terrorism and catastrophic incident

- Incorporated pre-existing exercises under one scenario and control architecture

- Dates: April 18-28, 2017, & May 9-11, 2017
  - Prevent/Protect: April 18-23, limited CDC participation
  - Response: April 24-28, primary window for CDC activities (April 24-27)
  - Recovery: May 9-10, select CDC leader participation

Activities Leading to the Gotham Shield Exercise



Goals:

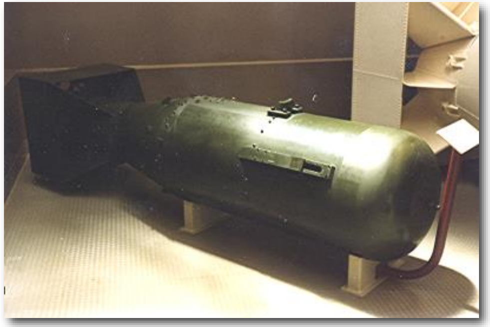
- Respond quickly and effectively to global public heath emergencies
- Decrease time to make meaningful response impact
- Continue to improve efficiency and effective internal/external partnerships

Gotham Shield 2017 Scenario

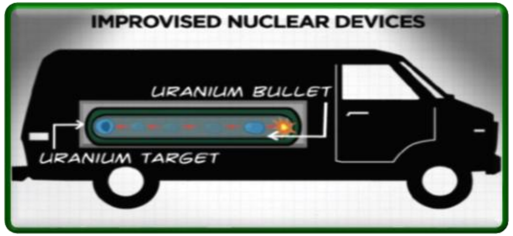
- National Planning Scenario (NPS) #1: Nuclear Detonation—Improvised Nuclear Device (IND)
- Intel indicates a terrorist threat of nuclear detonation—when or where unknown
  - Gun-type nuclear device using highly enriched uranium
  - Smuggle into United States
  - Assembled near a major metro center
  - Transport to large city using a van and detonate
- IND (10-kt) Detonation in large U.S. city
  - Detonation: Ground level at noon
  - Weather: Clear, light haze, and light breeze; no snow or no clouds
  - Casualties: Hundreds of thousands
  - Infrastructure Damage: Total w/n radius of 0.5 to 3 miles
  - Evacuations/Displaced Persons: 100K in area seek shelter (decon required to enter shelters); 250K shelter in place; 1M+ self-evac
  - Contamination: Various levels approx. 3K square miles
  - Economic Impact: Hundreds of billions $$
  - Recovery Timeline: Years

What's the difference between an Airburst and Surface Burst?

- An airburst is a nuclear detonation in which the fireball does not touch the Earth's surface
  - These maximize blast effects and minimize fallout. Less debris is sucked up by the mushroom cloud thereby producing less fallout
- A ground burst is a nuclear detonation in which the fireball does touch the Earth's surface
  - These cause much more debris to be sucked up into the mushroom cloud. This radioactive debris then becomes fallout



"Little Boy"



Example of Radiation Team Activities

- Content development and review (for Joint Information Center products)
  - Majority of effort
- Advisory team environment, food and health
- Input - Medical countermeasures Q&A
- Input - worker safety and health
- CRC operational guidance
- State and local needs
- Data needs/cost of registry for workers and public
- Briefings, conference calls, etc…

Examples of Questions that Required Message Development

- Is the large number of fatalities unusual? How does this compare to the Japan earthquake?
- Should we expect more fatalities as a result of this event?
- How is CDC involved in the investigation of this event?
- Does the federal government plan to activate their medical countermeasures supply?
- Do CDC officials receive MCM before the general public?
- Will points of distribution be set up to pass out medical countermeasures?
- How soon will CDC provide medical countermeasures to the general public?
- Why is potassium iodide not relevant to this response?
- Why is internal contamination not relevant to this response?
- Will this affect women of childbearing age who want to have children later?
- Are sanitation workers at risk in picking up soiled diapers and other waste from people in the affected area?

Radiation Response Guide for Key Leaders and Public Health Decision Makers

Adela Salame-Alfie Ph.D.
Radiation Studies Branch
National Center for Environmental Health

During a radiation emergency, state and local authorities will need to quickly assess the degree of the hazard and issue the appropriate protective actions to people in the affected area.

Terminology – CBRN Threats
Chemical, Biological, Radiological, Nuclear

- A **radiological** incident does NOT involve a nuclear detonation
- A **nuclear** incident involves a nuclear detonation

- Both
  - Can happen in unforeseen locations
  - Apply to all States and jurisdictions

Potential Radiation Events

- Transportation
- Power Plant
- Weapons
- Laboratory
- Industrial
- Medical
- Space
- Terrorism

Radiological Dispersal Device (RDD)

- A device that disperses radioactive material by ***conventional*** explosive (dirty bomb) or other mechanical means, such as a spray
- Contamination and exposure hazard

Nuclear Emergencies

- A nuclear emergency involves the explosion of a nuclear weapon or improvised nuclear device (IND)
- The explosion produces an intense pulse of heat, light, air pressure, and radiation
- Nuclear explosions produce fallout (radioactive materials that can be carried long distances by the wind)

Key Information Needed

If *nuclear* incident:

- Type of device (IND, state sponsored)
- Size of device
- Direction of the plume
- Radioactive decay (how quickly radiation levels decrease)

- If *radiological* incident:
- Type of incident (RDD, RED, transportation, nuclear power plant, industrial)
- Radionuclide(s) involved
- Half-life of radionuclide
- Physical form of material (liquid, solid, gas)
- Are medical countermeasures available for this radionuclide

Key Information Needed

- Impacted areas
  - Extent of contamination
  - Radiation levels
  - Critical infrastructures and services
- Impacted population
  - Number living/working in the area
  - Transient (working/visiting)
  - Special events (sports or other events)
- Primary radiation hazards (exposure/contamination)
- Other hazards (fires, collapsed buildings, secondary devices, …)
- Response assets needed to address hazards identified (search and rescue, fire, hazmat, medical…)

Key Information Needed

- Safety precautions considerations:
  - First responders (police, fire, EMS)
  - First receivers and hospital personnel
  - Other emergency workers and volunteers (public works, bus drivers aiding evacuation, staff at CRCs/shelters, etc.)

- Communications
  - Available channels
  - Technical experts (SME and communications) who can craft messages

- Agencies to contact
  - For notification
  - For assistance

Information Supports Decision Making

Determine *the most appropriate initial protective action* for people in the affected area

For accidents that evolve *slowly,* such as a nuclear power plant:

- It may be possible to evacuate people from an area before contamination gets there, but…
- Evacuating large populations presents other hazards…may put people at higher risk than the potential exposure
- So, make sure to consider potential risks of evacuation before issuing evacuation order

Protective Action Recommendations/Decisions

For incidents that develop *quickly* (such as terrorist act)

- Best course of action is to *shelter-in-place* until radiation experts assess the hazard and provide further instructions
- An RDD is *unlikely* to distribute enough contamination to present a serious exposure hazard… but leaving a safe structure will put people at risk for *internal and external contamination*

Shelter-in-place is the recommended protective action after an IND, because:

- Radioactive fallout from an IND presents *a serious exposure hazard -* going outside will expose people to potentially very high levels of radiation
- Staying inside a sturdy building provides shielding and reduces exposure
- Radioactive fallout loses energy quickly and becomes less dangerous as time passes
- After 24-48 hours, radiation levels will decrease to a fraction of initial levels

Roles and Responsibilities

- Response by federal Agencies is outlined in Nuclear/Radiological Incident Annex to the Response and Recovery Federal Interagency Operational Plans (NRIA) of the National Response Framework (NRF)

    - Defines roles and responsibilities
    - Discusses specific authorities, capabilities and assets that the federal government can bring to bear
    - Discusses how the assets will organize ***and operate in conjunction with each other and with local and state response partners***

Public Health Responsibilities

- Conducting population monitoring
- Initiating health surveillance and epidemiological investigations for workers and the public
- Coordinating the distribution of medical resources/countermeasures
- Communicating guidance regarding use of altered standards of care and managing scarce resources

Population Monitoring

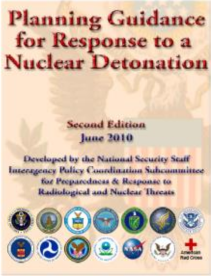
- *Likely to be the most challenging responsibility for state and local public health.*
- Population monitoring begins *soon after a radiation incident is reported* and continues until all potentially affected people have been monitored and evaluated for:
  - Need for medical treatment
  - Presence of radioactive contamination on the body or clothing (external contamination)
  - Intake of radioactive materials into the body (internal contamination)
  - Removal of external or internal contamination (decontamination)
  - Radiation dose received and resulting health risk from the exposure
  - Long-term health effects

Population Monitoring (cont’d)

- These assessments, *except for the evaluation of people for long-term health effects*, should be accomplished as soon as possible following the incident
- Health officials will need to establish a population registry and conduct epidemiologic investigations to evaluate people for long-term health effects. *This process may span multiple decades*
- While local health agencies may initiate population monitoring*, state and federal assets will be needed to augment local resources*

Considerations for Population Monitoring after an IND

- Population monitoring activities and decontamination services should *remain flexible and scalable* to reflect the prioritized needs of individuals and availability of resources at any given time and location
- The *immediate priority* of any population monitoring activity is *identification of individuals whose health is in immediate danger and requires urgent care*
- The *primary purpose* of population monitoring following a nuclear detonation is *detection and removal of external contamination*. In most cases, external decontamination can be self performed if straightforward instructions are provided
- *Prevention of acute radiation health effects* should be the primary concern when monitoring for radioactive contamination
- *Radioactive contamination is not immediately life threatening*



https://www.fema.gov/media-library-data/20130726-1821-25045-3023/planning_guidance_for_response_to_a_nuclear_detonation___2nd_edition_final.pdf

Phases of Radiation Emergency Response

Early Phase

- Those actions required for life-saving and immediate protection from radiation and radioactive materials
- Often based on limited information or projections (modeling)

Intermediate Phase

- Typically involve protecting individuals from *chronic exposure* to radioactive materials on the ground, bodies of water, or incorporated in or deposited on food products

Late Phase

- Activities designed to return the affected area to normalcy

Federal Assets

Department of Energy (DOE)

- National Atmospheric Release Advisory Center (NARAC)
  - Predictive plots and maps showing affected areas
- Radiological Assistance Program (RAP)
  - On-call radiation protection personnel from national laboratories
  - Respond at the request of state officials
- Aerial Measuring System (AMS)
  - Rotary- and fixed-wing aircraft outfitted with radiation detection equipment
- Federal Radiological Monitoring and Assessment Center (FRMAC)
  - Multiagency organization responsible for *coordinating* radiological monitoring, sampling and assessment activities
- Radiation Emergency Assistance Center/Training Site (REAC/TS)
  - Medical asset that provides medical advice, training, and on-site assistance for treatment of radiation injuries

Federal Assets

- Environmental Protection Agency (EPA)
  - RadNet
    - Network of 130 radiation monitoring stations. Provides real time radiation monitoring in all 50 states
    - Monitors air, precipitation, drinking water samples
  - Airborne Spectral Photometric Environmental Collection Technology (ASPECT)
    - Fixed-wing aircraft that provides real-time chemical and radiological monitoring
    - Can deploy within nine hours of notification
  - Radiological Emergency Response Teams (RERT)
    - Works with federal, state and local agencies to monitor radioactivity and clean up affected areas

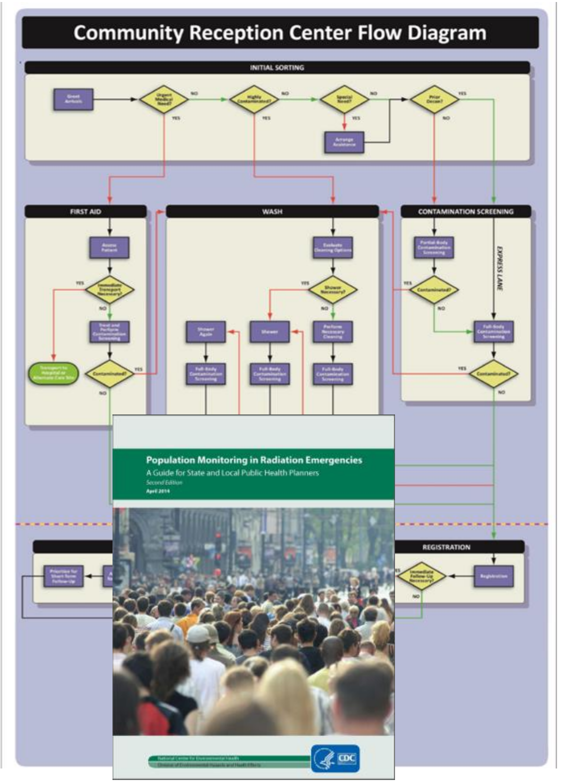
Federal Assets

- Advisory Team for Environment, Food and Health (Advisory Team)
  - Representatives from EPA, USDA, FDA, and CDC plus other agencies as needed
  - Interprets information provided by FRMAC, NARAC, and other resources
  - Provides recommendations to the coordinating agency and local/state decision makers regarding matters of health (including animal health), the environment and food
  - Advice includes:
    - Interpretation of EPA Protective Action Guides (PAGs)
    - Actions to minimize contamination of food and water
    - Actions to minimize ingestion of contaminated food and water
    - Relocation of members of the general public
    - Return of the general public to areas which had been previously evacuated

Community Reception Center (CRC) Drill Toolkit

Main Features:

- Customizable templates for all aspects of a drill, from planning to conduct to evaluation
- More than 100 different contamination cards for actors simulating affected individuals
- Demographic and behavioral cards designed to help planners incorporate the needs of special/vulnerable populations in the drill
- Compliant with U.S. Department of Homeland Security's Homeland Security Exercise and Evaluation Program (HSEEP) guidance



*Centers for Disease Control and Prevention (CDC). *Population Monitoring in Radiation Emergencies: A Guide for State and Local Public Health Planners, Second Edition.* 2014. 10 May. 2016 http://emergency.cdc.gov/radiation/pdf/population-monitoring-guide.pdf

Internal Contamination Measurements – Urine Bioassay

Radiation Laboratory Methods (bioassay):

- Rapidly identifies and quantifies specific radionuclides in people potentially contaminated in a radiological or nuclear incident
- Provides critical information for effective medical management of individuals by assessing risk for medical management and follow-up
- Provides information for population monitoring (populations and population sub-groups)
- Provides “negative” results for people who think that they may be contaminated but are not truly contaminated

CDC Laboratory Bioassay Methods

Based on:

- A “spot” urine sample of ~ 10 mL or less (radionuclide dependent)
- Rapid “screening” methods for gamma emitters and alpha/beta emitters
- Measurement of 22+ priority threat radionuclides (identification and quantification)
- CLIA-compliant analytical methods
- Total laboratory throughput of 300 to 500 samples per day (radionuclide dependent)
- Uses 6 different analytical technologies for the 22+ radionuclides
- Method detection limits based on the NCRP 166 Clinical Decision Guide for a child or pregnant woman with sample collection 5 or more days post contamination time

NCRP 166: Population Monitoring and Radionuclide Decorporation Following a Radiological or Nuclear Incident

Medical Countermeasures

Greg Burel, Director
Susan Gorman, Associate Director for Science
Division of Strategic National Stockpile

Medical Management of Radiation Casualties

- Some incidents may lend themselves to the use of radioprotective drugs
- These drugs work in one of the following ways
  - Blocking internal contamination from being absorbed in particular organs (such as KI)
  - Binding internal contamination to speed up excretion from the body (such as Prussian Blue, DTPA)
  - Stimulating the bone marrow to produce white blood cells (granulocyte colony stimulating factors or G-CSF such as filgrastim, pegfilgrastim, or others)
- Some of these drugs work on very specific radionuclides; not all would be useful in a detonation Depending on the nature of the incident, the distribution of medical countermeasures may be widespread (e.g. KI) or very selective (e.g. DTPA)
- The efficacy of these drugs depends to a large extent on the timeliness of administration

Acute Radiation Syndrome

- Also known as radiation sickness or ARS
- Serious illness that develops when a person receives a *high dose of radiation*, usually *over a short period of time*
- People exposed to radiation will get ARS *only* if:
  - Radiation dose was high
  - Radiation was able to reach internal organs (penetrating)
  - Person’s entire body, or most of it, received the dose
  - Radiation was received in a short time, usually within minutes
- Symptoms of ARS include:
  - Nausea
  - Vomiting
  - Headache
  - Diarrhea
- *Symptoms and severity vary depending on the dose*

Treatment of ARS

- Treatment focuses on reducing and treating infections, maintaining hydration, and treating injuries and burns
- Some patients may benefit from treatments that help the bone marrow recover its function
- The lower the radiation dose, the more likely the person will recover from ARS
- Cause of death in most cases is the destruction of the person's bone marrow, which results in infections and internal bleeding
- Recovery process may last from several weeks up to 2 years

Medical Countermeasures for Internal Contamination and Radiation Injury

Countermeasure	Radionuclide	What it Does	Timeframe
Potassium Iodide (KI)	Radioactive iodine	Saturates thyroid gland with stable iodine thus blocking uptake of radioactive iodine	Before exposure (most protective) or within 4 hrs post exposure
Prussian Blue	Cesium and thallium	Binds cesium and thallium and keeps them from being absorbed. Contamination excreted in feces	As soon as possible after internal contamination. Most effective in the first few days; still effective later
DTPA	Plutonium, americium and curium	Binds plutonium, americium and curium and keeps them from being absorbed. Contamination excreted in urine	As soon as possible after internal contamination. Most effective within 24 hrs
Filgrastim, pegfilgrastim, or others	Used to treat high dose radiation exposure. Not radionuclide specific	Stimulates bone marrow to produce new white blood cells. Helps patients fight off infections during recovery	As soon as possible after laboratory testing confirms drop in white blood cell count

Communications in a Nuclear Emergency

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Environmental Hazards and Health Effects
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Communications in a Nuclear Emergency

Radiation presents communications challenges

- Radiation is
  - Invisible
  - Silent
  - Odorless
  - Detected with specialized equipment
- Radiation concepts, terms, and risks are poorly understood by the public
- Radiation elicits fear and is associated with unsurvivable disaster or cancer

Effective Communication Saves Lives

- Decreases illness, injury, and death
- Helps response and recovery efforts
- Gives people positive actions to take
- Reduces rumors and misinformation
- Minimizes unnecessary visits to hospitals and other critical facilities
- Reduces stigma

Involve communicators at every stage of preparation and response.

Specific Issues in Radiation Communication

- Myths and misperceptions
- Complex terms
- Confusing units of measurement
- Countermeasures (when to take, when not to take, how they are distributed)
- Communications infrastructure limitations – how will you get the messages out?

Lessons Learned from Audience Research

- The public's most persistent concern at each stage of the scenario, even in low-risk situation: **What should I do to protect myself and my family?**
- Participants do not like messages that convey uncertainty by having *may*, *might*, or *could* in the message
- People overestimate risks and resist "reassuring" messages
- People do not believe simple measures work (e.g., decontamination)
- Many people will not shelter-in-place; will seek family and children even when it increases their risk
- People will be more likely to take protective actions if they understand why
- Pregnant and nursing women will follow instructions from authorities

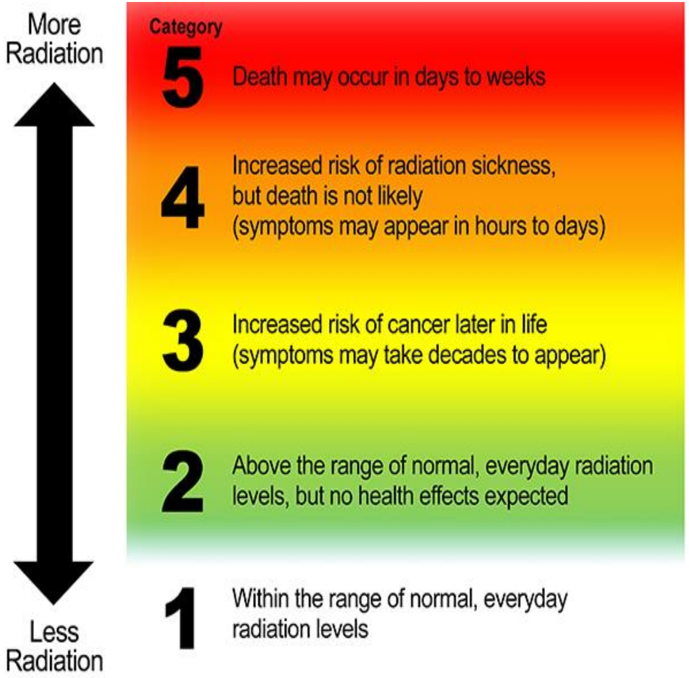
Effective Communication Strategies

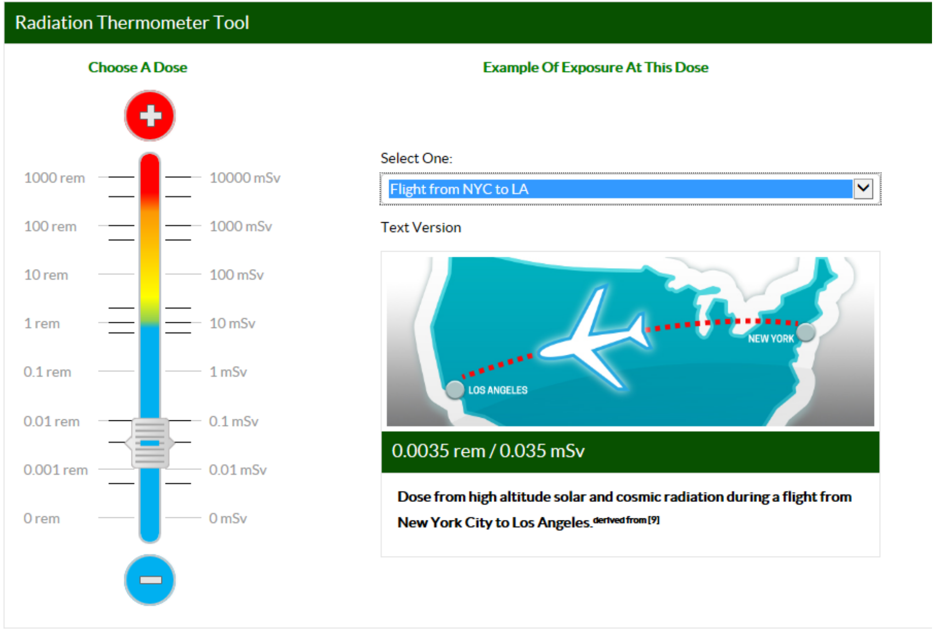
To dispel myths and communicate effectively about radiation:

- Give clear, easy-to-follow protective actions to people
- Tailor the actions to the specific audience and geographic area
- Give people context
- Use comparisons
- Acknowledge uncertainty, understanding it is uncomfortable

Communication Tools to Provide Context

CDC Radiation Hazard Scale and Risk Thermometer





*This is a logarithmic scale, where each gray line represents a ten times increase or decrease in the dose, rather than a one unit increase or decrease.

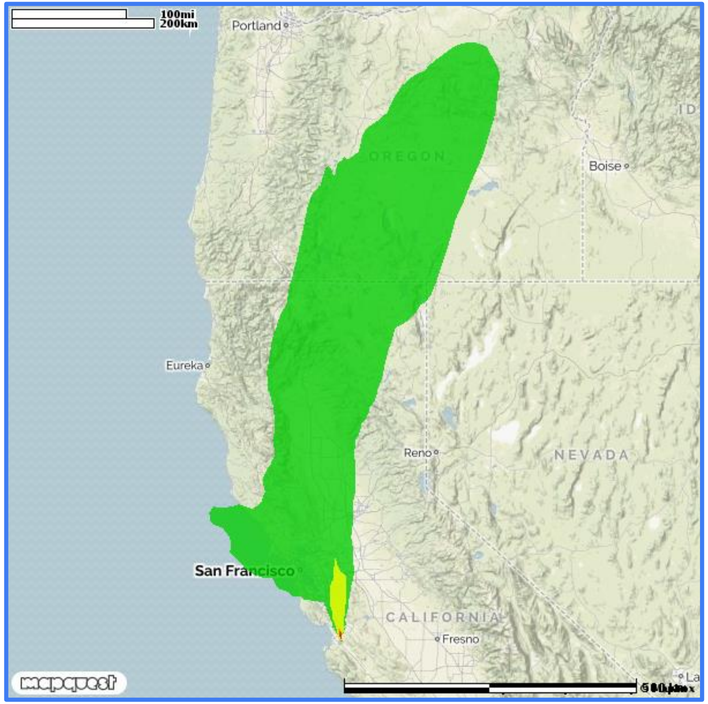
Example for Demonstration Only

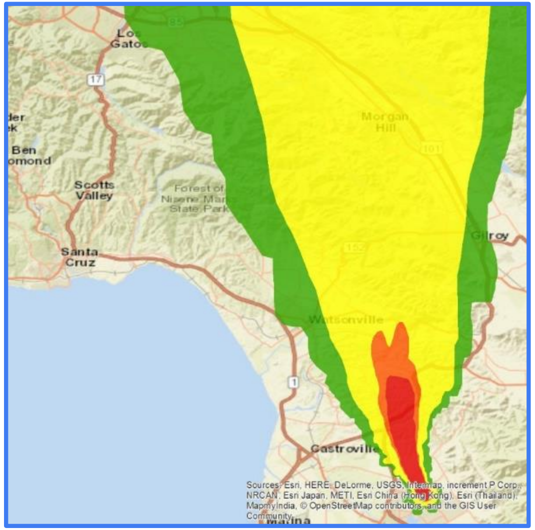
APPROVED PRODUCT NARAC National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

Predicted Area for Potential Radiation Hazard in the Fallout Area

Total external dose from radioactive fallout during first 24-hour after release





Category 5 | Category 4 | Category 3 | Category 2 | Category 1

- **10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; confirm with measurements.**
- **Model assumes that no shelter or other protective actions have been taken to decrease exposure.**

Produced: 06 Jul 2016 22:40 UTC

Advice & Recommendations: CDC 800-232-6348

Example for Demonstration Only

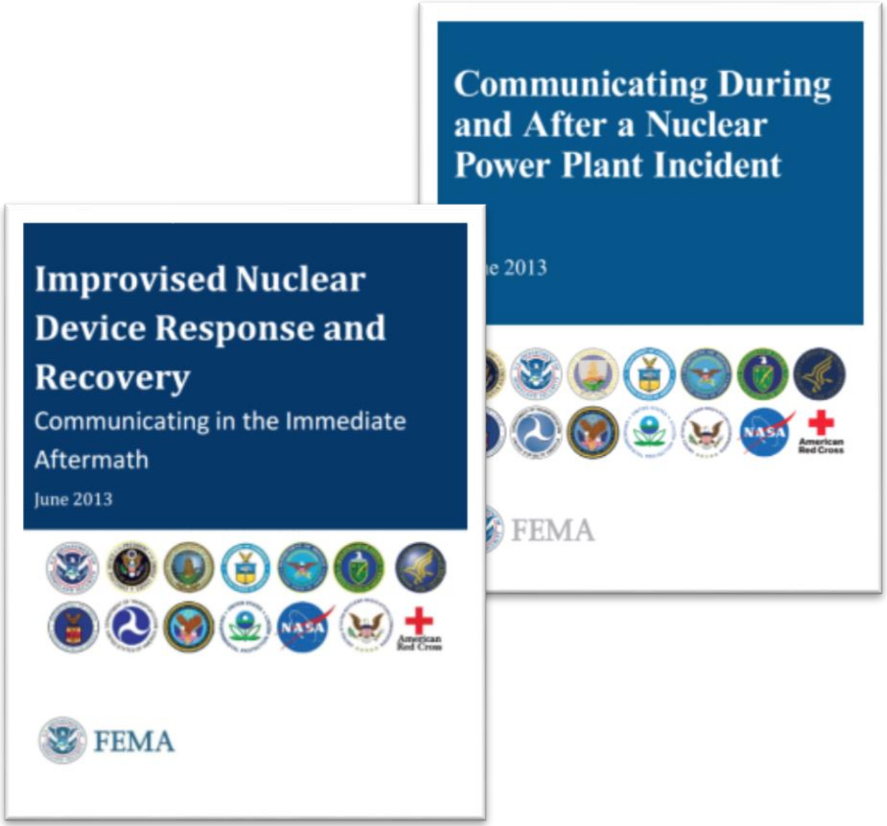
Beta.rcE19694.rcC1

Communicating with Professional Audiences

- Public health professionals, clinicians, and other professionals have misunderstandings and fears similar to the public
- Let clinicians and other professionals know how to protect themselves and the low level of risk they face
- Addressing contamination issues should not delay treatment of life-threatening injuries

U.S. Government-Prepared Radiation Messaging

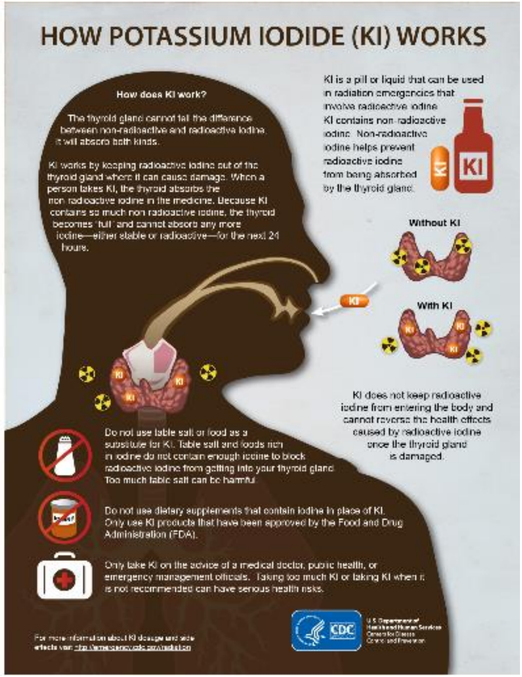
- **Question:** How do we coordinate incident messages across all levels of government during a large-scale radiological incident?
- **Answer:**
  - Agree on messages in advance
  - Put the messages in writing
  - Practice



Example: Potassium Iodide (KI) messaging

Do I need to take potassium iodide (KI) if there is a nuclear blast?

Local emergency management officials will tell people when to take KI. If a nuclear incident occurs, officials will have to find out which radioactive substances are present before recommending that people take KI. If radioactive iodine is not present, then taking KI will not protect people. If radioactive iodine is present, then taking KI will help protect a person's thyroid gland from the radioactive iodine. Taking KI will not protect people from other radioactive substances that may be present along with the radioactive iodine.



CDCemergency CDC Emergency
Do NOT take Potassium Iodide (KI) in US b/c of nuclear pwr plants in Japan, #japan http://go.usa.gov/4hR
18 Mar

KI (Potassium Iodide)

View Low Resolution Video

Messages are shared in a variety of formats (Twitter, video PSA, infographic)

If something were to happen tomorrow, how quickly can you get this message out?

CDC Communications Training and Tools for Radiation Emergencies

- Myths of Radiation: Communicating in Radiation Emergencies https://emergency.cdc.gov/radiation/radiationmyths.asp
- Radiation Basics Made Simple https://emergency.cdc.gov/radiation/radbasics.asp
- Training for Poison Control Centers on Radiation Risk Communication https://www.cdc.gov/radiationtraining/RAD-ToolKit/Training/#/module5/page1
- Crisis and Emergency Risk Communication Online and In-Person training https://emergency.cdc.gov/cerc/training/basic/index.asp
- Radiation Hazard Scale https://emergency.cdc.gov/radiation/radiationhazardscale.asp
- Radiation Thermometer https://emergency.cdc.gov/radiation/radiationthermometer.asp
- Infographics https://emergency.cdc.gov/radiation/resourcelibrary/infographics.asp
- Protective action and educational videos https://emergency.cdc.gov/radiation/protectiveactions.asp
- Radiation Dictionary https://emergency.cdc.gov/radiation/glossary.asp

CDC Next Steps

Questions & Answers

Please send additional questions to Preparedness@cdc.gov. Have a great evening!

Thank You!

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov