Radiation Incidents: Communication and History

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Lecture Objectives

- Understand the perception of risk - especially for radiation
- Understand some basic communication techniques
- Understand what radiation can cause
- Understand what radiation does not cause

Importance of HP Integration

An understanding of the basic health physics concepts is important because it helps build the foundation for understanding the mechanisms of radiation injury.

Additionally, it is essential that good communications occur between the medical and health physics staffs.

Historical Questions

- What is a radiation “accident”?
- How many radiation “accidents” can I expect in a year?
- What are the main types of radiation injury / illness?
- What is a radiation “accident” victim? Is he radioactive?
- What are the risks to myself, my colleagues/staff, ambulance, or hospital in responding to a radiation accident or in treating a radiation accident victim?
- What do I do first – what are my priorities with radiological / nuclear event victims?

What is a Radiation Accident?

- IAEA: An <u>unintentional</u> event involving exposure or contamination of persons and/or the environment by radioactive material
- Alternately: An <u>unexpected</u> incident involving exposure or contamination of persons and/or the environment by radioactive material
- Real or suspected?

Typical Calls for Assistance

- Administration of radioiodine for diagnostic or therapeutic purposes to a woman who was unknowingly pregnant at the time of the procedure. What is the fetal dose? Medical advice?
- A worker unwittingly handled an industrial radiography source. What are the medical ramifications associated with the radiation dose?
- My child was sitting by the microwave and I think I "nuked" him!

Risk Perception

Real Risk does not equate to

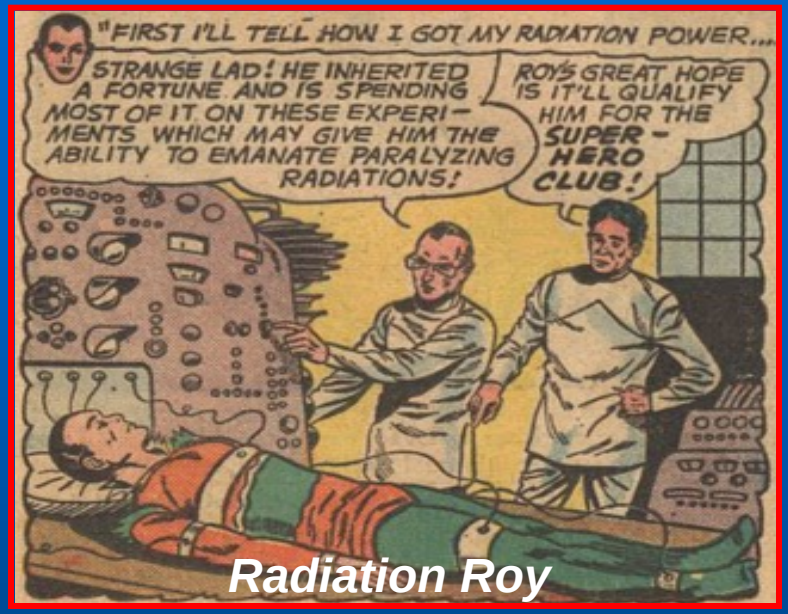
Perceived Risk does not equate to

Acceptable Risk

Perception

- Where do we get our perceptions about radiation and radioactive materials?
- What is your perception of risk?
- What is your risk from an irradiated patient?
- What is your risk from a radioactively contaminated patient?

Public "Education"



Radiation Roy

X-Ray

Factors Influencing Risk Perception

More Acceptable		Less Acceptable
Voluntary	vs	Externally imposed
Under self-control	vs	Controlled by others
Clear benefits	vs	Little or no benefits
Fairly distributed	vs	Unfairly distributed
Natural	vs	Manmade
Statistical	vs	Catastrophic
From a trusted source	vs	From an untrusted source
Familiar	vs	Unfamiliar or Exotic
Affects adults	vs	Affects children

Natural Radiation Exposure

Air

About 30,000 atoms disintegrate each hour in our lungs and give off alpha or beta particles and some gamma rays.

Food & Drink

About 15 million potassium-40 atoms and about 7,000 natural uranium atoms disintegrate inside every one of us each hour.

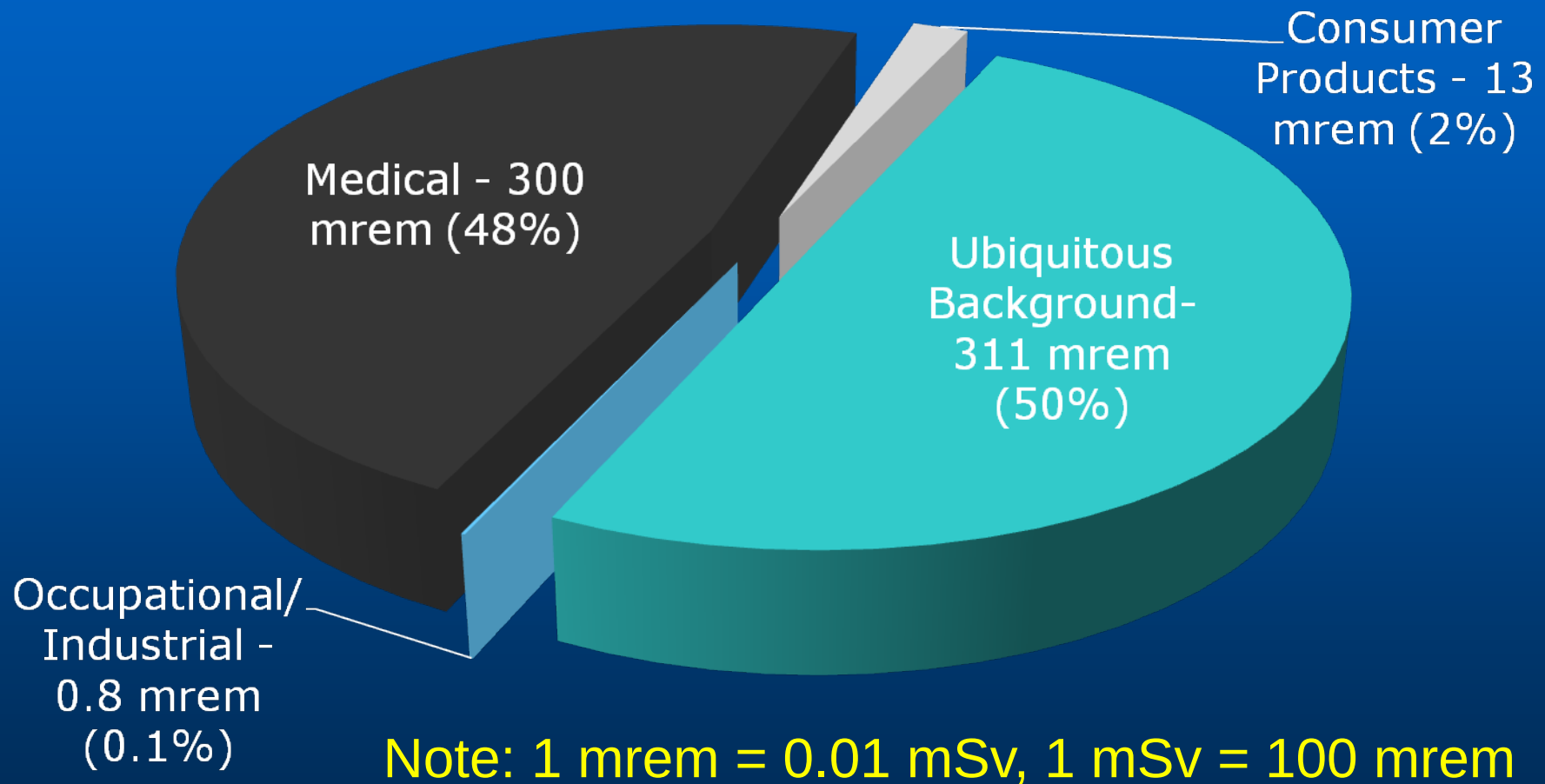
Soil & Building Materials

Over 200 million gamma rays pass through the average individual each hour.

Sky

About 100,000 cosmic ray neutrons and 400,000 secondary cosmic rays penetrate the average individual every hour.

625 mrem: Ionizing Radiation Exposure of the US Population - 2006 (NCRP-160)



Note: 1 mrem = 0.01 mSv, 1 mSv = 100 mrem

Dose Criteria for Designation as a Radiation Accident

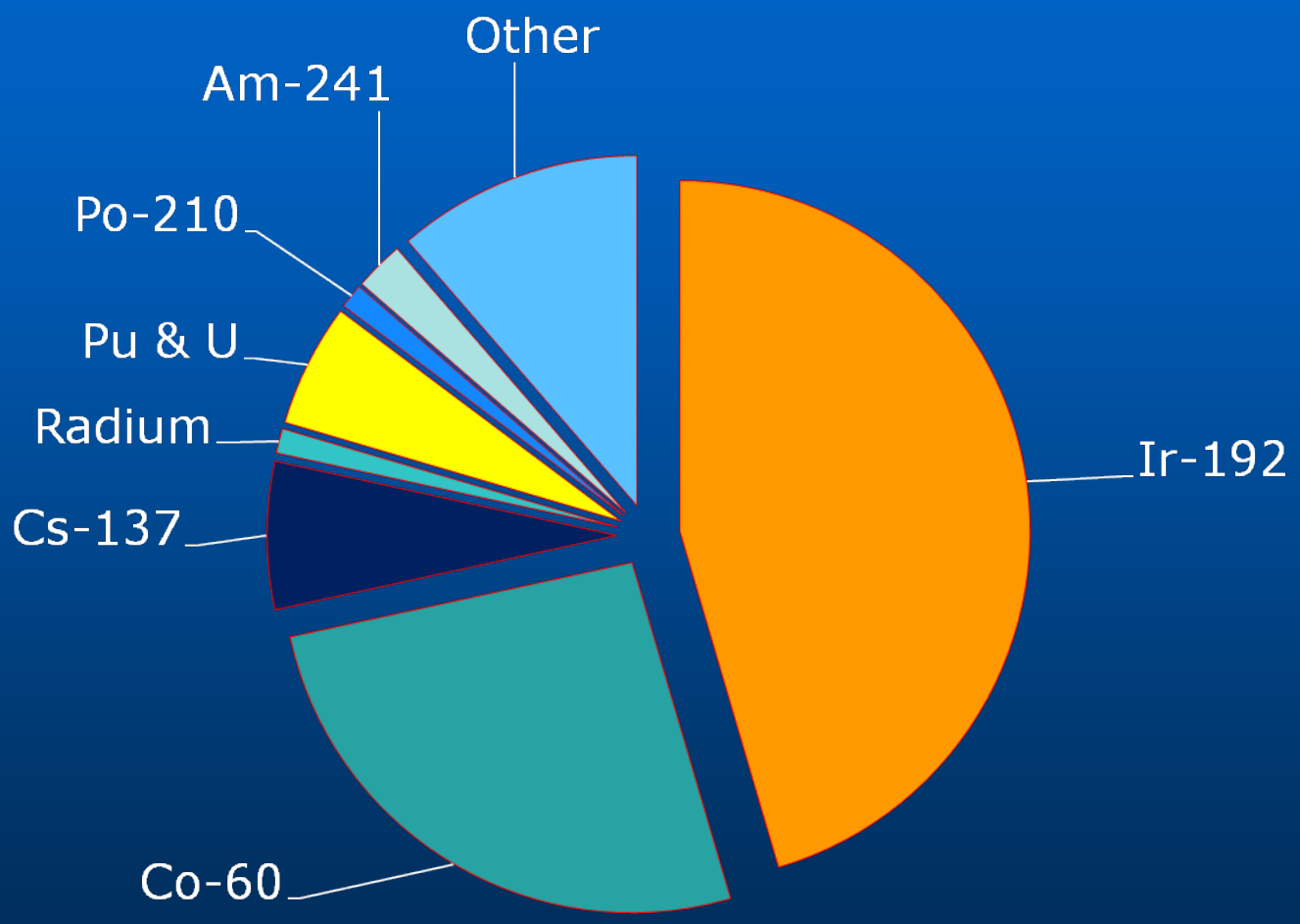
Condition	Criteria Sv (rem)
1. Total Effective Dose (whole body, internal committed and external deep dose	0.25 (25)
2. Equivalent Dose to Skin or Any Extremity	2.5 (250)
3. Total Organ Equivalent Dose (internal + external contributions to organ dose)	2.5 (250)
4. Medical Misadministration	Medical Misadministrations have to exceed the 10CFR35.3045 reporting criteria AND exceed the doses listed above.

Where Do Radiation Accidents Occur?

- Irradiation facilities
- Nuclear reactors
- Isotope production facilities
- Materials testing (sealed sources)
- Materials testing (x-ray devices)
- X-ray and radiotherapy devices (medicine, research)
- Unsealed radionuclides (medicine, research)
- Transportation
- ????

Source: DOE-REAC/TS Radiation Accident Registry

Accidents by Source



Common Causes of Radiation Accidents

- Lost or mishandled sources
- Medical misadministration
- Bypassing Interlocks
- Failure to use criticality control
- Calibration/programming errors
- Inadequate radiation protection programs, supervision/quality control, and training/written procedures
- Human factors

The Bottom Line: Human Error

MAJOR RADIATION "ACCIDENTS" WORLDWIDE (1944-Feb 2012): "CLASSIFICATION BY DEVICE"

Radiation Devices		**324**
Sealed Sources	214	
X-ray Devices	84	
Accelerators	25	
Radar Generators	1	
Radioisotopes		**101**
Diagnosis and Therapy	44	
Transuranics	28	
Fission Products	11	
Tritium	2	
Radium Spills	1	
Other	15	
Criticalities		**20**
Critical Assemblies	8	
Reactors	6	
Chemical Operations	6	
Source: REAC/TS Registry	**Total**	**445**

MAJOR RADIATION "ACCIDENTS" WORLDWIDE 1944-Feb 2012: ACUTE, ASSOCIATED, AND NON-RADIATION DEATHS

United States

New Mexico	3
Ohio	10
Oklahoma	1
Pennsylvania	1
Rhode Island	1
Texas	9
Wisconsin	1
Total U.S.	**26**

Non-radiation deaths	
Canada	1
Idaho	3
USSR	3
Washington	1
Total	8

Other

Algeria	2
Argentina	1
Belarus	1
Brazil	4
Bulgaria	1
China (PR)	6
Costa Rica	7
Egypt	2
El Salvador	1
Estonia	1
Israel	1
Italy	1
Japan	2
Marshall Isl	1
Mexico	5
Morocco	8
Norway	1
Panama	5
Russia	5
Spain	10
Thailand	3
USSR	29
UK	3
Yugoslavia	1
Total Non-U.S.	**102**

LETHAL RADIATION ACCIDENTS - USA

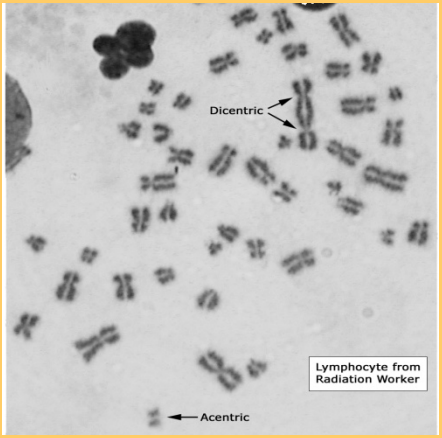
United States	Deaths	Cause
Ohio	10	Medical misadministration ^{60}Co – wrong graph paper used –underestimate of source strength and increased time of exposure
Texas	9	2 teletherapy equipment malfunction “54”– 25MeV 7 ^{90}Y loss from therapeutic microspheres
Pennsylvania	1	Retained brachytherapy source – ^{192}Ir
Wisconsin	1	Medical misadministration – ^{198}Au – miscalculation of “micro” to “milli” Ci
New Mexico	3	Multiple criticality accidents
Rhode Island	1	Criticality
Oklahoma	1	Radiography source - probable suicide
Total	26	

Cytogenetic Biodosimetry Capability

- "Gold" standard for acute whole body radiation dose assessments
- A national emergency response asset:

  Utilizes metaphase spreads of lymphocytes to search for chromosome aberrations (dicentrics) specific to radiation exposures

Old



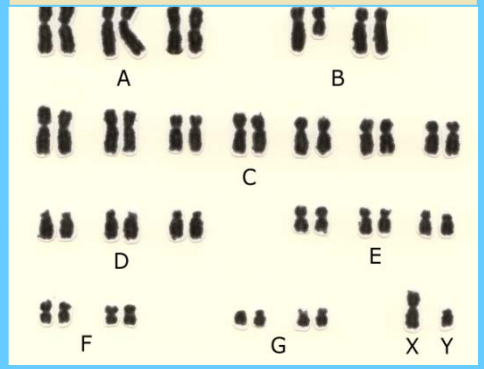
Labor Intensive

New

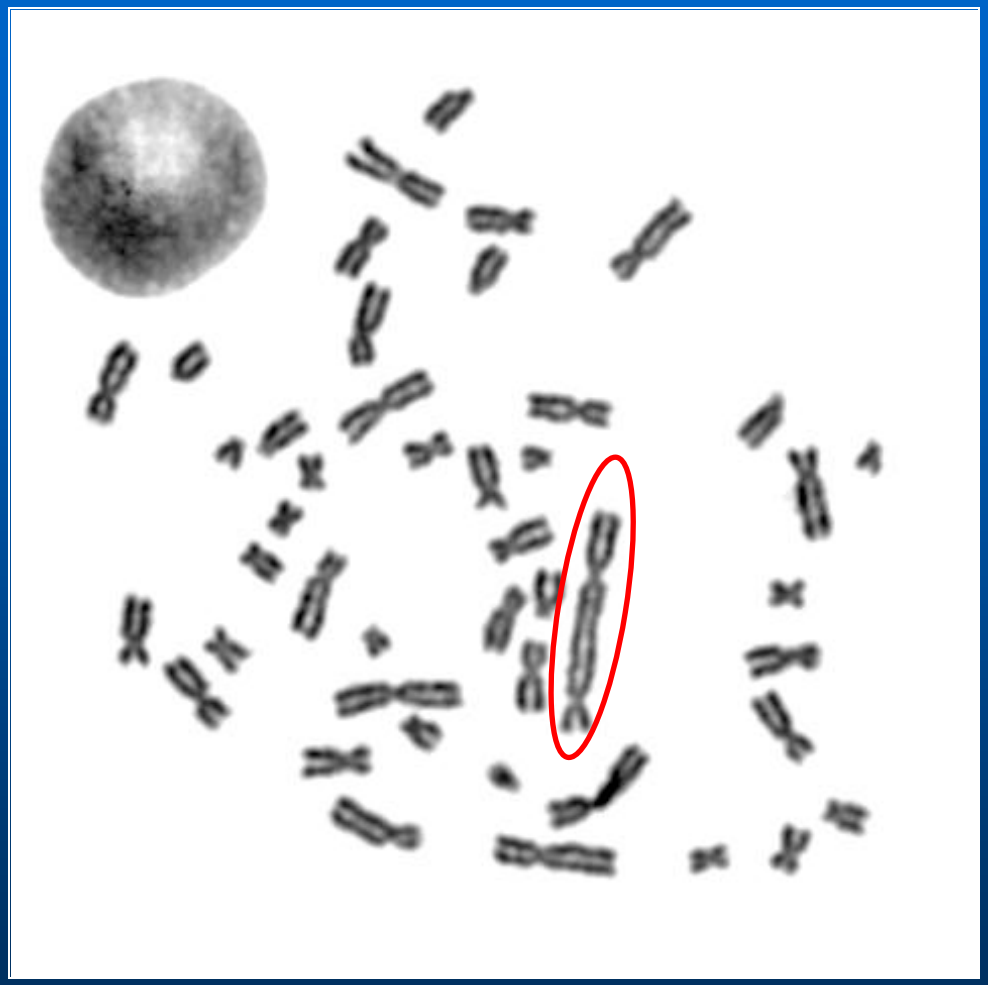
Automated Cytogenetics Workstation

Output

Karyotype



Dicentric Chromosome



Radiological Illness/Injury Issues

- Acute Radiation Syndrome (ARS)
- Local burns
- Contamination
- Combined injuries

Yanango, Peru: IAEA

Sarov, Soviet Union: IAEA

Radiation Can Cause

Nausea, Vomiting	1/2 - 48 Hours
Lymphocyte Depletion	Hours to Days
Immunosuppression	7-30 Days
Granulocytosis	1-7 Days
Thrombocytopenia	15-30 Days
Granulocytopenia	15-30 Days
Death from shock	6-48 Hours

Other Consequences of Radiation Accidents

- *Psychological*
  - Effects on individuals
  - Effects on families/co-workers
  - Effects on the general population
  - Effects on emergency response and health care personnel
- *Environmental*
  - Contamination of air, water or land
  - Waste management
  - Impact the food chain
- *Economic*
  - Use loss
  - Import/export restrictions
  - Clean-up costs
- *Legal*
  - Impact on regulatory agencies
  - Damages and legal costs
  - Medical/legal uncertainties

Radiation Does Not Cause

- Immediate death
- Immediate burns, wounds

Irradiation or contamination alone are not a medical emergency, or threat to responders, other persons or facilities, therefore –

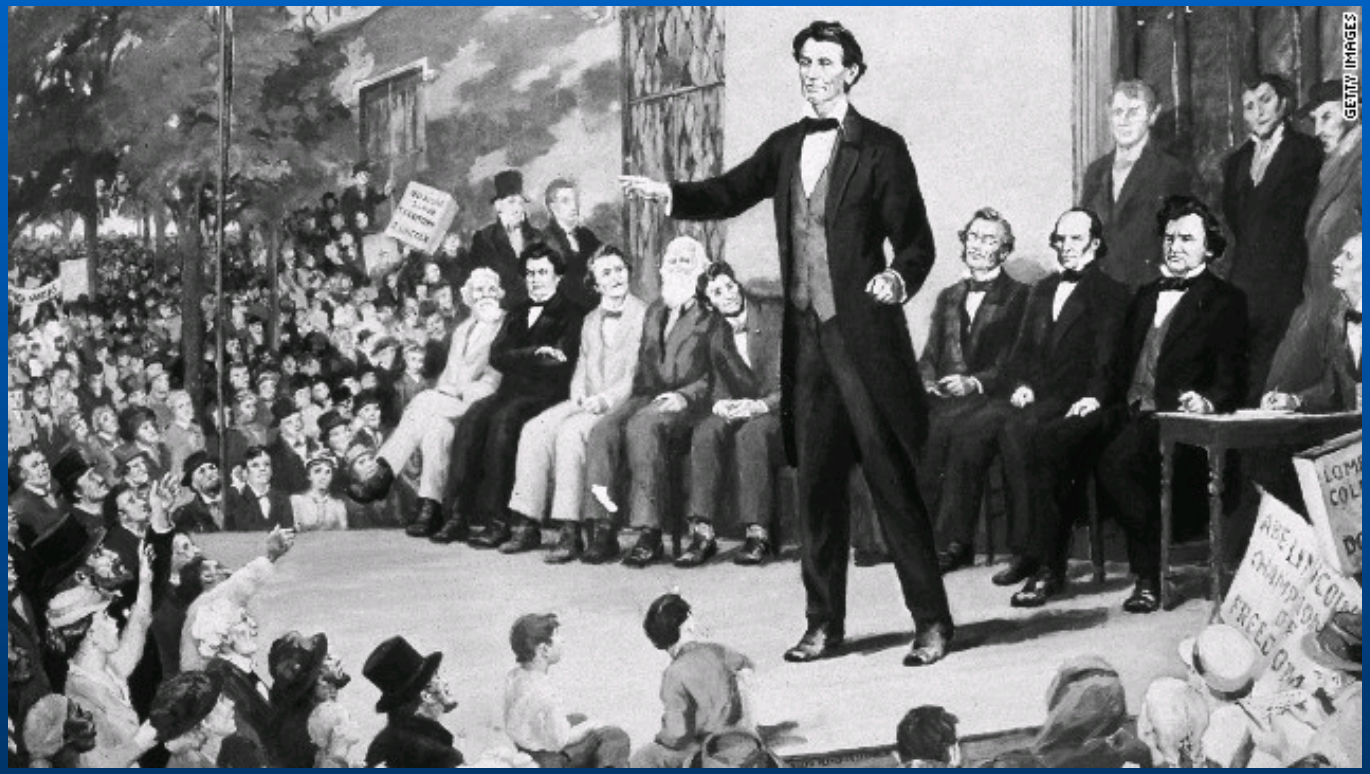
Treat <u>significant</u> medical conditions first – then deal with radiological conditions.

When Communicating…

- Tell the truth
- Keep it simple, but accurate
- Avoid acronyms
- Not everybody has the same perceptions, be flexible

GOP's radioactive anti-Obama rhetoric

By **John Avlon**, CNN Contributor updated 4:03 PM EST, Wed February 22, 2012



An illustration depicts an 1858 Lincoln-Douglas debate: Avlon says today's GOP campaigns are more Buster Douglas.

John Avlon is a CNN contributor and senior political columnist for Newsweek and The Daily Beast. He is co-editor of the new book "Deadline Artists: America's Greatest Newspaper Columns."

U.S. scraps plan for anti-radiation pills

By Mimi Hall, USA TODAY

Updated 1/29/2008 10:30 AM

WASHINGTON — The federal government will not give anti-radiation pills to millions of people who live 10 to 20 miles from a nuclear plant because there are more effective ways to protect people in case of an accident or terrorist attack, the White House said Monday.

(Name Deleted) holds a pack of potassium iodide tablets in 2002. (Name Deleted) bought anti-radiation pills for his family and employees in case of a radiation emergency. The president's top science adviser concluded Monday that there are more effective ways of protecting Americans during a nuclear crisis.

CBS News.com
New York,
Oct. 23, 2007
By Keach Hagey

White House May Halt Anti-Radiation Pills. The Skinny: Plan Born Of Terror Fears Scrapped To Boost Confidence In Nuclear Power

Is the White House admitting that global warming is scarier than terrorism?

That seems to be the message behind USA Today's report that the Bush administration may scrap a plan to give anti-radiation pills to millions of people, five years after Congress ordered that the tablets be made available to anyone living within 20 miles of a nuclear reactor.

The New York Times

Anti-radiation Pills Are Urged for Children

Published: Tuesday, April 8, 2003

Households, schools and child-care centers near nuclear power plants should keep potassium iodide pills on hand to protect children from thyroid cancer in the event of a release of radiation, the American Academy of Pediatrics has recommended.

Children are especially vulnerable to the effects of radiation, in part because they are closer to the ground, where fallout settles and because their bodies absorb and metabolize substances differently, the pediatrics academy said.

? ? QUESTIONS ? ?