2010 Public Health Preparedness Summit

Radiation Emergencies – An Integrated Public Health Response

Welcome!

- *Please turn off cell phones or place on vibrate.*
- *If an alarm sounds, please locate your nearest emergency exit.*
- *Please sign-in at the headtable if you are seeking CE credit.*

2010 Public Health Preparedness Summit

WANTED:

YOUR FEEDBACK ON CDC's RADIATION EMERGENCY TOOLKITS

2010 Public Health Preparedness Summit

Are You?

- Involved in Emergency Preparedness:
  - Nurses or Doctors
  - Public Health Trainers
  - Public Health Planners
- Familiar enough with the toolkit(s) to discuss:
  - Uses of the toolkit
  - Strengths and weaknesses
  - Possible Improvements

2010 Public Health Preparedness Summit

If so…

- Please sign up for a 20 minute interview that will take place at booth 1504 in the exhibit hall.
- You will receive a token of appreciation for your time.

THANK YOU!!!

2010 Public Health Preparedness Summit

Radiation Emergencies – An Integrated Public Health Response

Agenda

2010 Public Health Preparedness Summit
Feb 16, 2010

Radiation Primer

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National Center for Environmental Health
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Past Experiences





7

New Orleans 2005








8

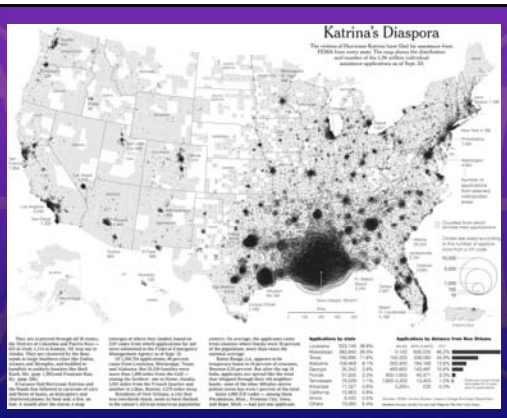
Haiti 2010



Nagasaki 1945







The New York Times, October 2, 2005

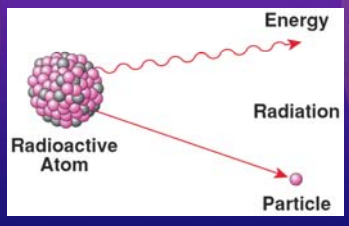
The Basics

- Radioactive decay
- "Ionizing" radiation
- Different types of radiation
- Irradiation and contamination (confusing use of the word "*exposure*")
- Half-life
- Natural radioactivity
- Radiation detection (dosimetry)
- Health effects

Radioactivity

Spontaneous emission of radiation from the nucleus of an unstable isotope

Disintegration **Decay**



Difference between:

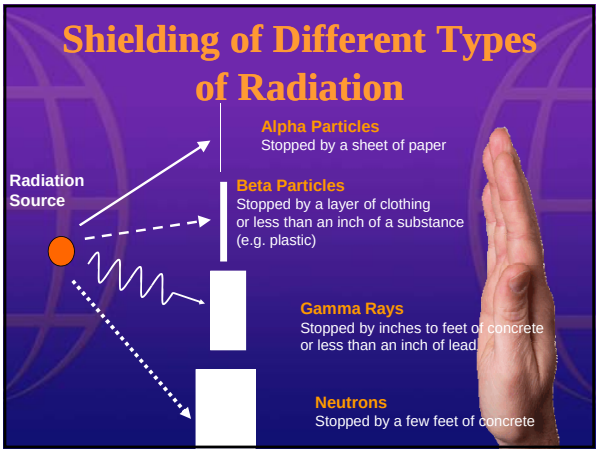
- Radioactive material
- Radiation

Difference between being:

- Contaminated
- Irradiated (exposed) → **External & Internal**

Radiation

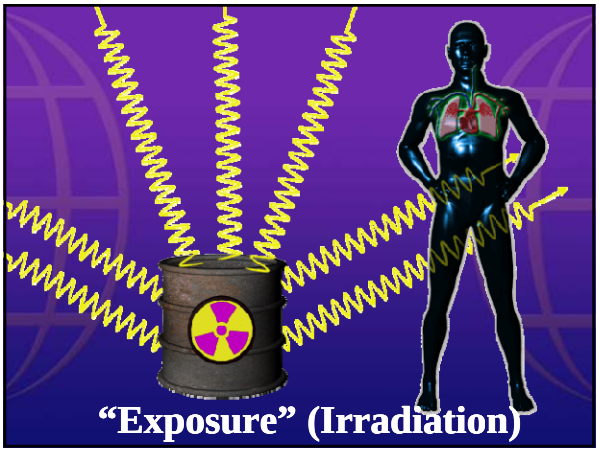
Shielding of Different Types of Radiation



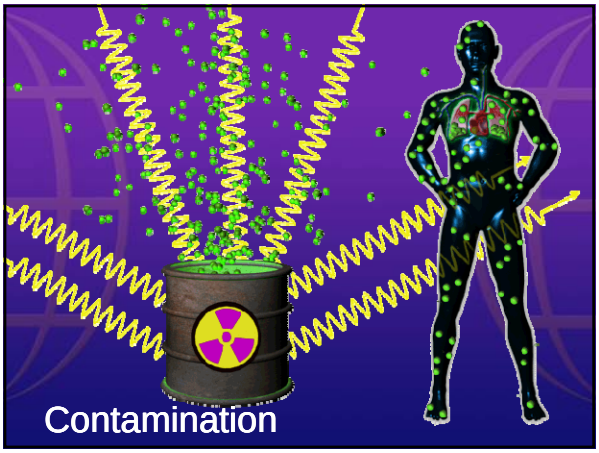
Exposure vs. Contamination

or

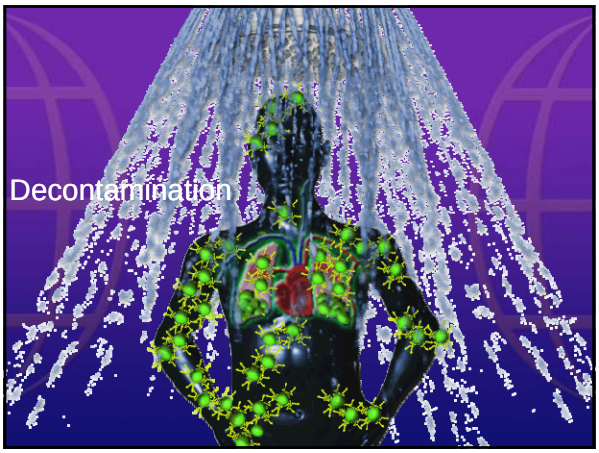
Irradiation vs. Contamination

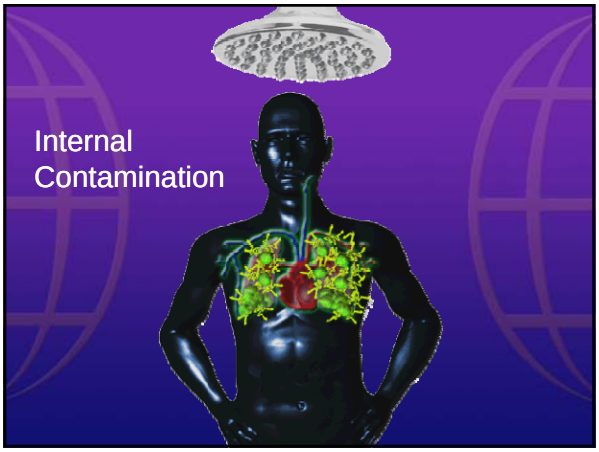


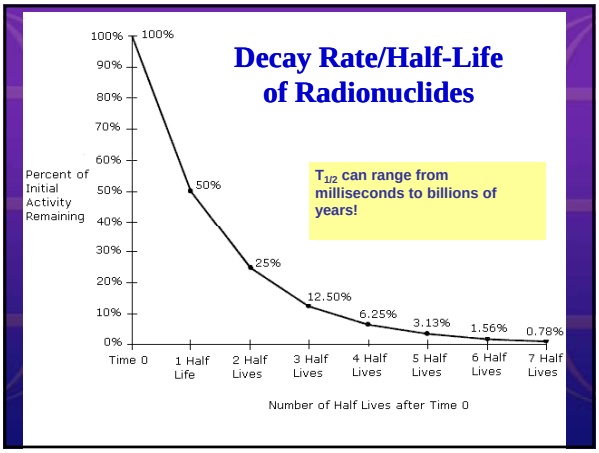
“Exposure” (Irradiation)



Contamination

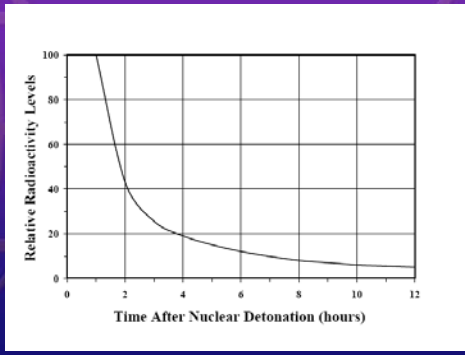

Decontamination


Internal
Contamination


Decay Rate/Half-Life
of Radionuclides
T1/2 can range from milliseconds to billions of years!
Percent of Initial Activity Remaining
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
100%
50%
25%
12.50%
6.25%
3.13%
1.56%
0.78%
Time 0
1 Half Life
2 Half Lives
3 Half Lives
4 Half Lives
5 Half Lives
6 Half Lives
7 Half Lives
Number of Half Lives after Time 0

Decay Rate/ Half-Life of Radionuclides

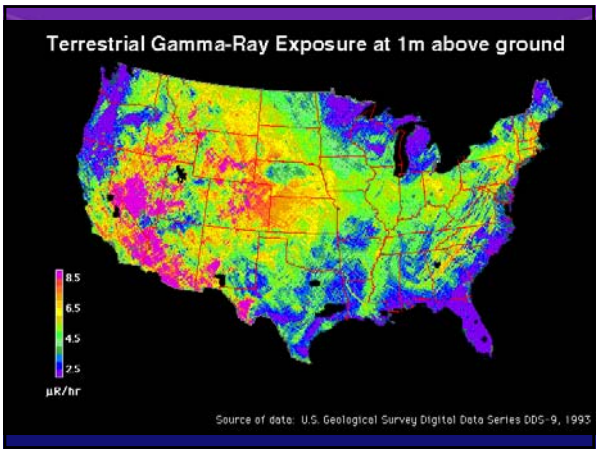
Example: Decay working to our advantage



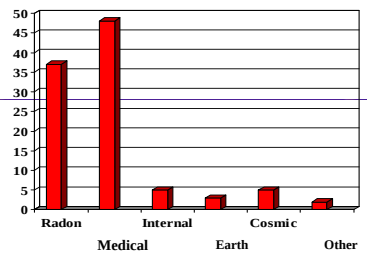
Radiation Units

- Amount of radioactivity
  - Curie (Ci), Becquerel (Bq)
- Ambient radiation levels
  - Roentgen per hour (R/h, rem per hour (rem/h)
- Absorbed dose
  - Rad, rem, Sievert (Sv)

Unit prefixes from Tera (10^{12}) to pico (10^{-12})



Percentage Contribution to Average Annual Radiation Exposure for U.S. Population (6.2 mSv; 620 mrem)



Dose Matters!

- Chest X-ray 0.03 rem
- Average annual dose from natural sources 0.3 rem
- CT scan (whole body) 1 rem
- Occupational limit (annual) 5 rem
- No detectable clinical effects < 25 rem
- Temporary reduction in WBC and platelets 25-100 rem
- Manifestations of radiation sickness 100-300 rem (recovery likely)
- Probable death in 50% of those exposed 300-600 rem
- Survival unlikely >1000 rem (whole body)

Radioactive Contamination

- **What if you ingested**
  - 12 Bq (disintegrations per second)?
    720 dpm (disintegrations per minute)
  - 5500 Bq?

- The point is not to trivialize radioactivity, but to put it in perspective.

Analogy: Curie (Ci) and Becquerel (Bq)

- Ci
- mCi
- uCi
- nCi
- pCi

- GBq
- MBq
- kBq
- Bq

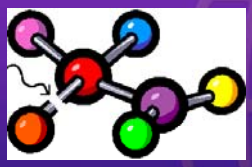
Detecting Radiation

We can not see, hear or smell radiation!!
But we can measure it.

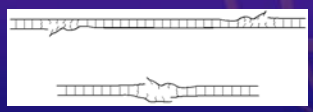
Detection and Instrumentation

What Could Ionization do to a Molecule?

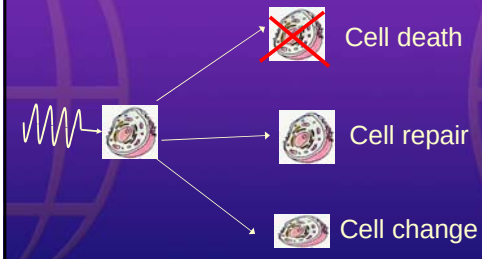
Ionizing radiation can break the bonds between the atoms in a molecule.



DNA is the sensitive target molecule in a cell



Cellular Effects



Health Effects

Depending on radiation dose and dose rate:

- No observable effects
- Acute effects (acute radiation syndrome)
- Late effects (cancer)

Acute Effects of Radiation Exposure

- 100-400 rem Nausea and vomiting, fatigue, loss of appetite, malaise; recovery likely within 3 months
- 400-600 rem: All of the above, plus diarrhea, fever, hemorrhage, inflammation of mouth/throat, emaciation
  - 50% of those exposed will die

Late Effects of Radiation Exposure

- Radiation can transform cells, leading to:
  - Late effects, primarily cancer
  - Years (decades) may pass between exposure and the effect
  - Risk persists throughout life
- Health effects highly influenced by variety of factors
  - radiation dose (no threshold)
  - age and gender person exposed
  - organ or tissue irradiated

Protective Measures

- Protection from external and internal radioactive sources can be achieved through effective use of:
  - Time, distance, and shielding
    (Examples: evacuation and sheltering)
  - Dosimetry and monitoring
- Radiological countermeasures for internal contamination, e.g., Potassium Iodide (KI)

Guiding principle for controlling exposures:

ALARA
As Low As Reasonably Achievable

Time

Decreasing the amount of time spent near the source of radiation will decrease the dose of radiation received.

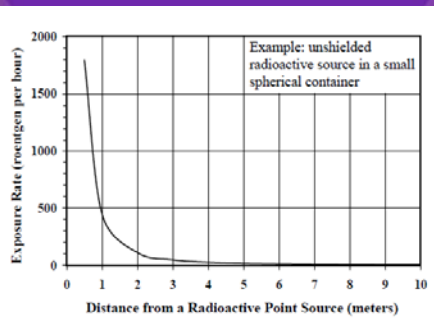
- Analogy - *Spend a day at the beach, you will likely get sunburned. But, if you limit time in the sun, you won't.*

Distance

The farther away you are from a radiation source, the less exposure you will receive.

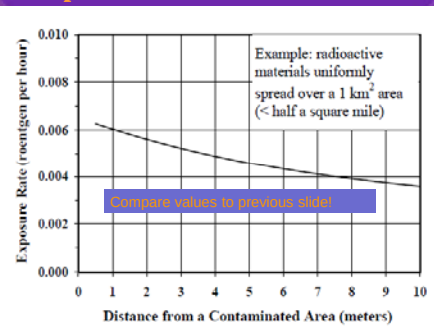
- Analogy - *Compare this to sitting in front of a fireplace. You can sit directly in front or across the room…*

Example: Goiania Source at a Distance



Source: *Radiation Threats and Your Safety*, A. Ansari, CRC Press, 2009

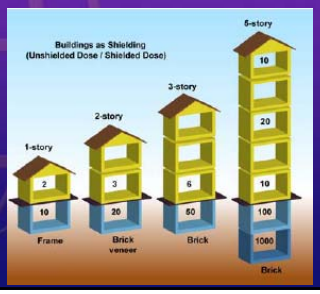
Example: Goiania Source at a Distance

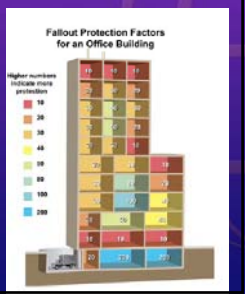


Source: *Radiation Threats and Your Safety*, A. Ansari, CRC Press, 2009

Shielding

Increased shielding between a person and the radiation source, will decrease the exposure.





Summary

- Learned the alpha, beta, gamma
- Learned the difference between:
  - being “exposed” (irradiated)
  - being contaminated
- Contamination can be:
  - external (on skin or clothing), or
  - internal (inhaled or ingested or through open wound)
- Radioactive contamination can be readily cleaned with mild soap and water

Summary (cont.)

- Radiation *can* kill in short term or cause health effects (cancer) in long term.
- Learned about practical methods to protect against or reduce exposure.
- It is all about dose!

Thank You

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