

BIODOSIMETRY:

AN OVERVIEW

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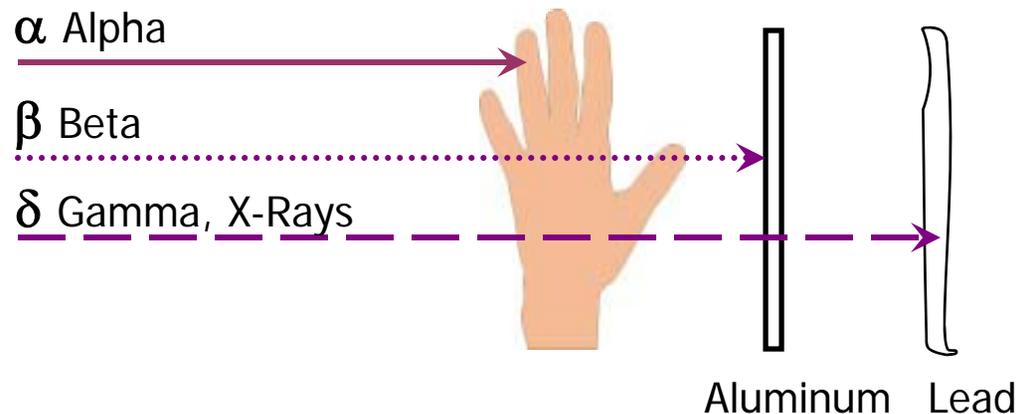


What is Radiation

Radiation is energy that is produced by a source and travels through any kind of material or space.

Sources

- High-energy atoms (e.g. radon, cobalt, iodine) tend to release or emit excess energy. This emission is called radiation.
- Radiation can also be produced by high voltage devices such as X-ray machines



Sources of Background Radiation

Normal annual exposure from natural radiation

Approx. 0.3 rem/yr



- Radon gas
- Human body
- Rocks, soil
- Cosmic rays

0.200 rem

0.040 rem

0.028 rem

0.027 rem



Normal annual exposure from man-made radiation

Between 0.030 - 0.070 rem/yr



- 1 chest X-ray
- Consumer Products
- Air Travel Round trip (NY-LA)
- Watching Color TV
- Sleeping with another person
- Nuclear industry

0.010 rem

0.010 rem

0.005 rem

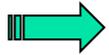
0.001 rem

0.001 rem

< 0.001 rem



BIODOSIMETRY What is it?



Ensemble of physiological, biochemical and molecular techniques used to monitor **biological indicators** in order to determine the dose of radiation that has **penetrated** into an individual.

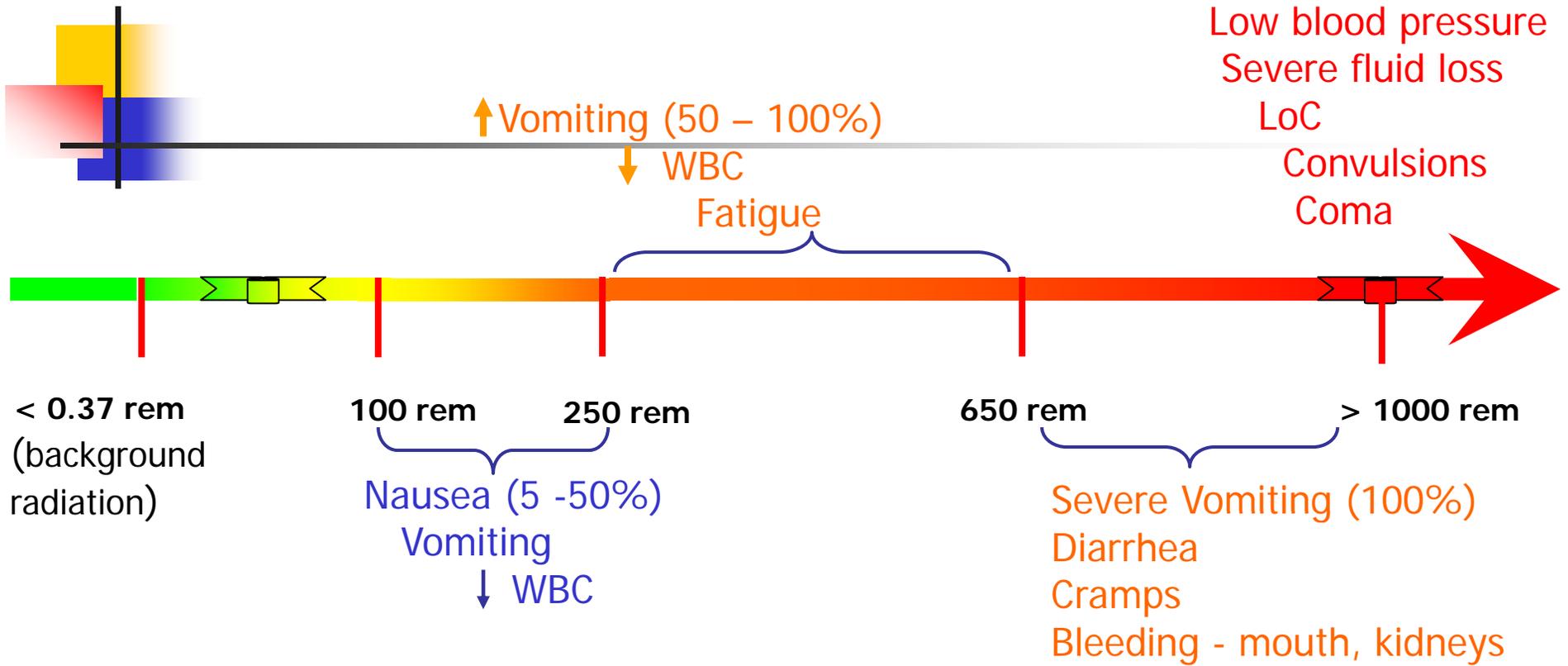


In contrast, PHYSICAL DOSIMETRIC methods, for example

- Film badge or thermoluminescence dosimeter
- Geiger counter
- Scintillation counter

monitor radiation in the immediate **environment** of an individual.

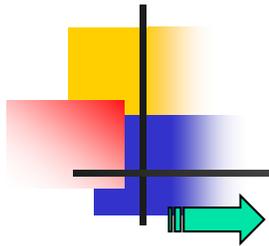
Clinical Symptoms as an Estimator of Radiation Dose



<u>Prognosis</u>		<u>Prognosis</u>	
■	Excellent	■	Good - poor
■	Very Good	■	Death

Severity and onset correlate directly with dose and inversely with prognosis

Lymphocyte Count As An Estimator of Radiation Dose



Initial blood sample for concentration of circulating lymphocytes should be obtained as soon as possible following radiation exposure



24 hours after initial assessment, additional comparative samples should be taken

Lymphocyte Levels
(% of initial count)

Early Consequences

~ Dose (rem)

100%

zero or minimal dose absorption

< 150

90 – 70%

moderate radiation injury;
prone to infections, slow wound healing

175 - 250

65 – 35%

severe radiation injury;
infections, hemorrhage

300 - 650

35 - 5%

potentially fatal dose;
general blood cell suppression

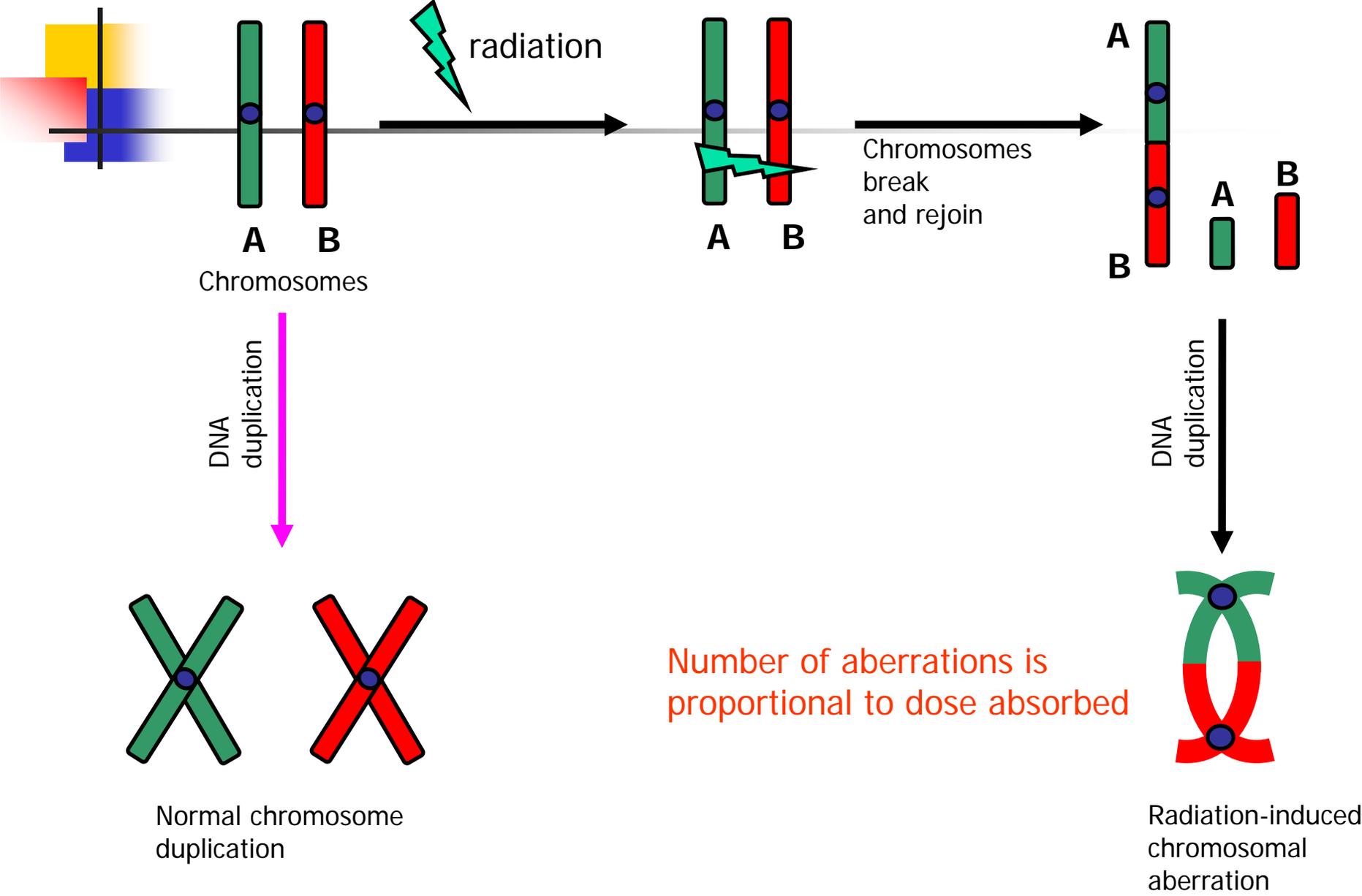
700 – 1 000

not detectable

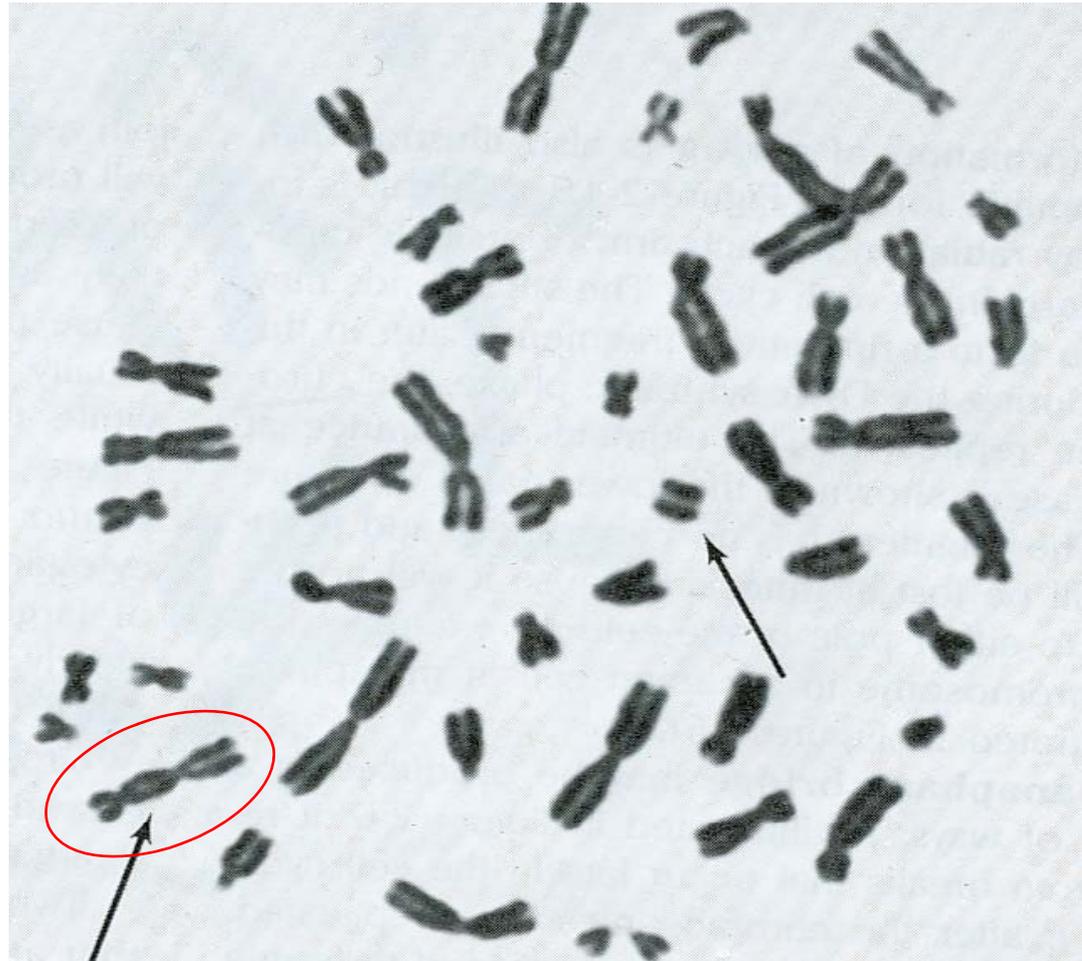
supralethal dose;
cardiovascular neurological damage

> 3 000

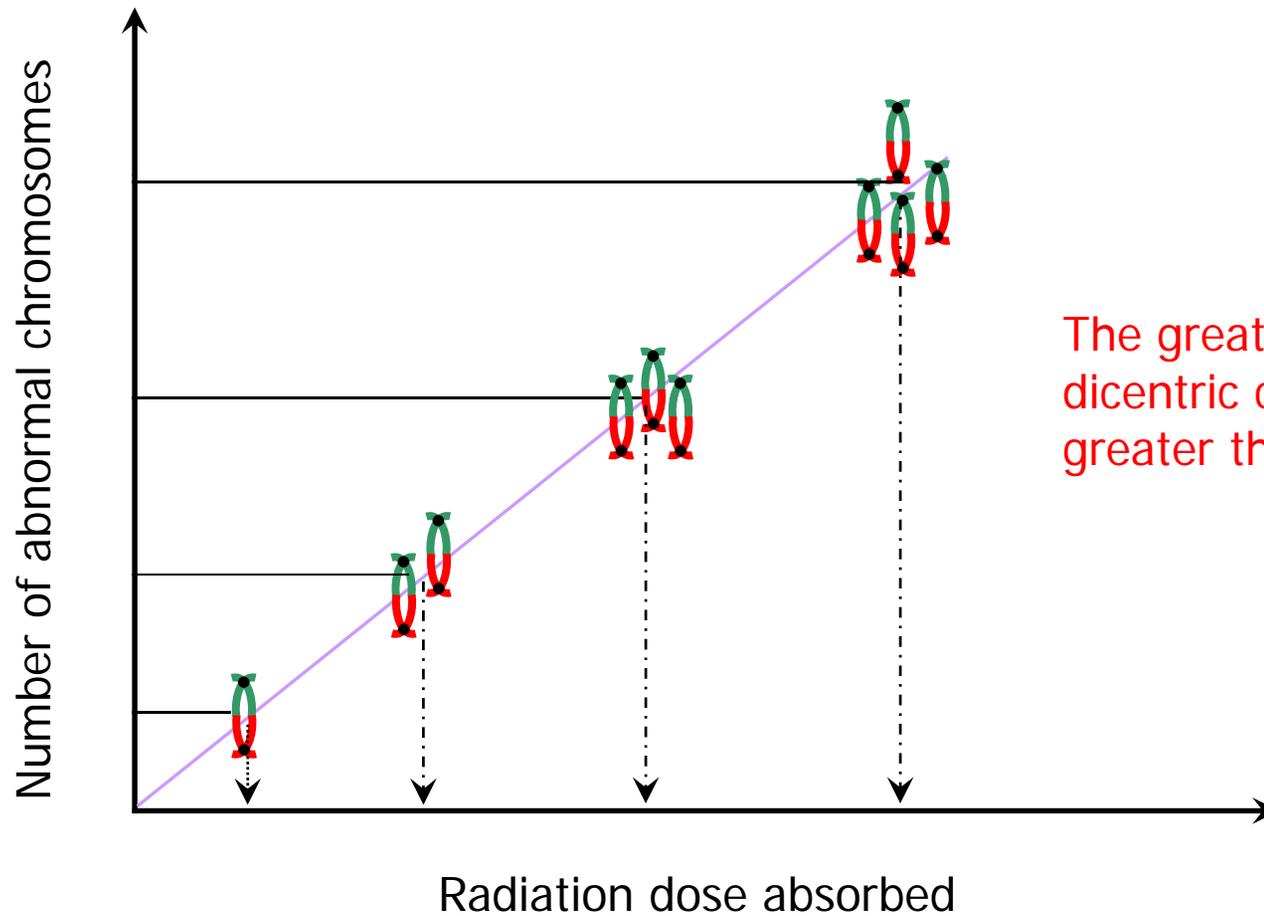
Basis of Chromosome Analysis (Dicentric Analysis)



Dicentric Chromosome Present In A Cell Treated With Low Dose Radiation

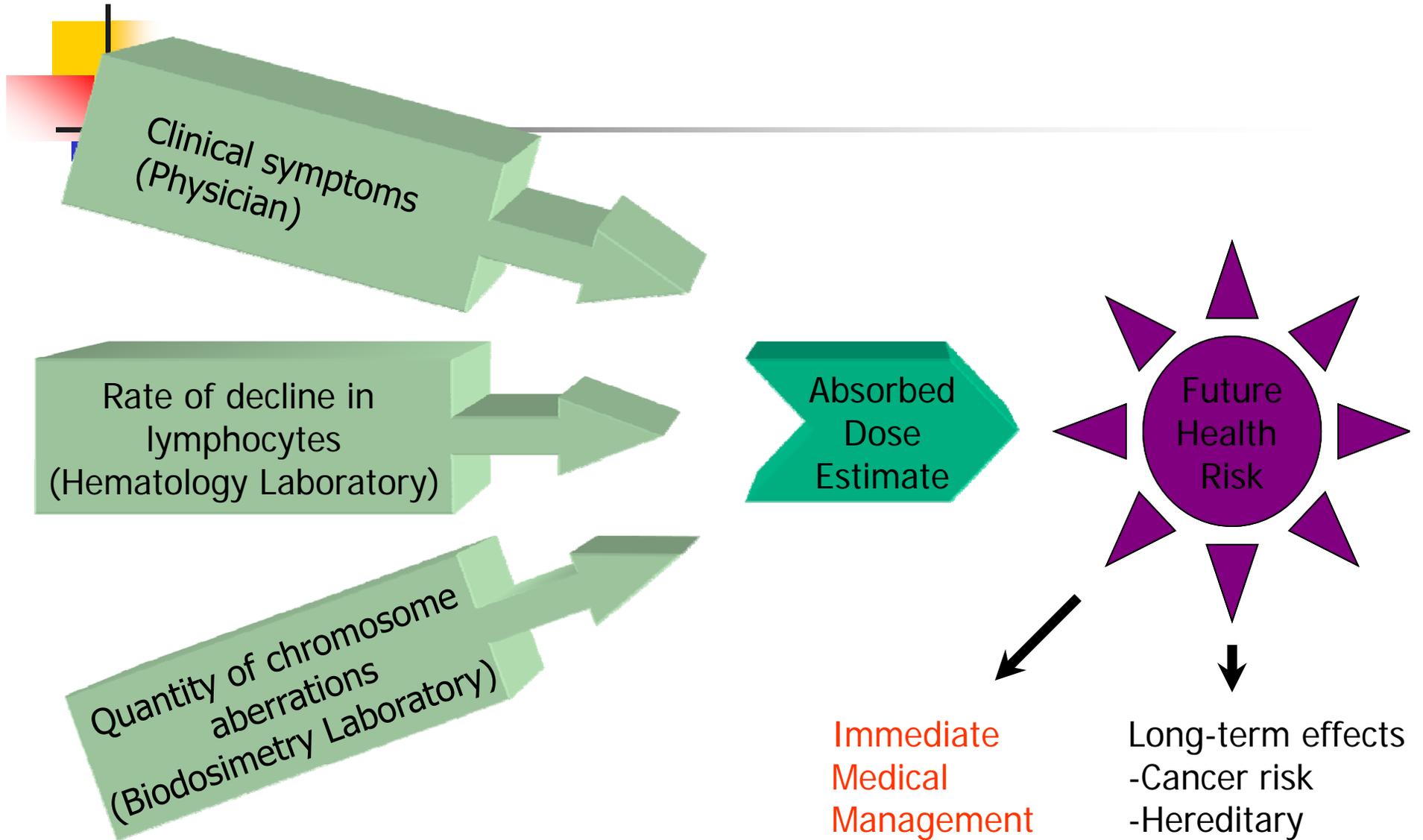


Radiation Dose Is Determined By the Number of Dicentric Chromosomes Observed in Cells

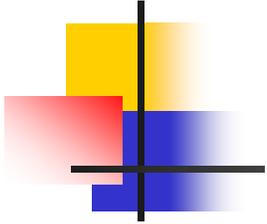


The greater the number of dicentric chromosomes, the greater the absorbed dose

Biological Indicators As Predictors of Health Outcome



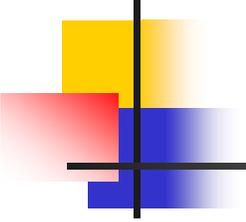
Responders To Terrorist or Accidental Dispersal of Nuclear Materials



- ▶ Local Fire and Police Departments, Emergency Medical Services (EMS)
- ▶ State Department of Environmental Protection (DEP) and Office of Emergency Management (OEM)
- ▶ HAZMAT teams
- ▶ Federal Bureau of Investigation
- ▶ Acute care hospitals and urgent care centers

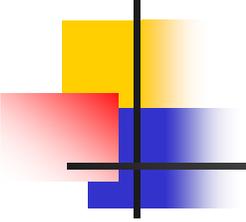
Responsibilities include:

- ▶ Limiting further damage
- ▶ Protecting the public
- ▶ Collecting and preserving evidence
- ▶ Decontamination
- ▶ Disposing of radioactive material
- ▶ Treatment of injured and walking wounded



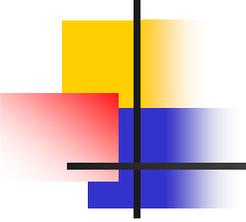
How the Biodosimetry Laboratory Can Assist Responding Agencies Meet Their Responsibilities

- ▶ Providing information regarding the likely clinical effects of radiation exposure.
- ▶ Identify a wider population that might have been exposed – does it involve other regions.
- ▶ Preliminary risk assessment regarding likelihood of long-term health effects.
- ▶ Test and confirm that the majority of individuals have not been exposed to radiation, thus maintaining order by alleviating anxiety



How the Biodosimetry Laboratory Can Assist Responding Agencies Meet Their Responsibilities

- ▶ Provide educational material explaining the basic principles of radioactivity in order to minimize fear of radiation that often affects individuals responding to radiological incidences.
- ▶ Provide educational program in order to instruct physicians how
 - ➔ Radiation levels are quantified in individuals
 - ➔ Radiation alters the function of cells
 - ➔ Victims with radiation injuries can be recognized



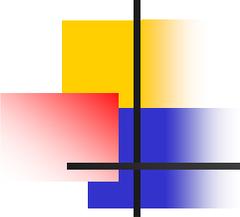
Biodosimetry Laboratory Requires Assistance In Incidences Involving Mass-Casualties

I. Hospital Radiation Safety Officer:

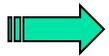
- ▶ Ensure that blood samples are drawn, in a timely fashion, from individuals that may have been exposed to radiation

II. Hospital Hematology Laboratory:

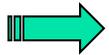
- ▶ Perform blood cell counts
- ▶ Isolation of white blood cells from whole-blood samples
- ▶ Initial preparation of white blood cells samples for DNA analysis (tissue culture).



Summary: Objectives of Biodosimetry

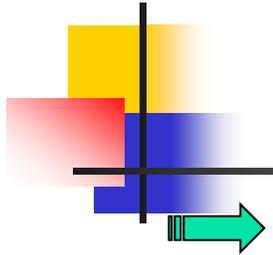


To assist in medical management of victims in the hospital for radiation accidents involving large numbers of casualties.

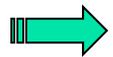


To predict short- and long-term health effects of radiation exposure.

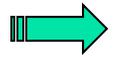
Summary: Role of the Biodosimetry Laboratory



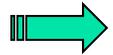
Develop protocols for blood collection and processing



Establish chain-of custody protocols to preserve evidence



Perform DNA damage analysis



Corroborate clinical information, with DNA analysis to predict short-term and protracted health consequences of **absorbed** radiation dose.



As part of the State of Connecticut Emergency Response, the Biodosimetry Laboratory will provide a training/education component regarding sample collection and processing.