

Rapid Response Actions for the Emergency Department in an Explosive Mass Casualty Radiological Incident

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Objectives

- ▶ Why this document was developed
- ▶ Understand that the actions in the ED are almost the same for a rad explosive incident as a non rad incident- need some modifications to lessen the nuisance of the radiological contamination
- ▶ Discuss the expected patient population that will arrive at the Emergency Department
- ▶ A short refresher of radiation

Why Develop a Document With the Excellent Material on the Internet?

- ▶ Radiological Emergency Medical Management Site
 - ▶ Comprehensive
 - ▶ Planning/early preparation phases
 - ▶ Timely to work through
 - ▶ Rapid Response document culls information that should be useful in the first hours of the incident

U.S. Department of Health & Human Services

REMM RADIATION EMERGENCY MEDICAL MANAGEMENT

Guidance on Diagnosis and Treatment for Healthcare Providers

- Understand Radiation
- Plan Ahead
- Practice Teamwork
- Work Safely

Interactive Clinical Tools ▾ Diagnosis & Treatment ▾ Reference & Data ▾ Overview ▾ Get REMM App 

What Kind of Emergency? 	Patient Management 	Initial Incident Activities 
› Nuclear Detonation: Weapons, Improvised Nuclear Devices › Radiological Dispersal Devices, Dirty Bombs › Nuclear Power Plant/Reactor Incidents › Radiological Exposure Devices › Transportation Incidents	› Choose Appropriate Algorithm › Contamination › Exposure (Acute Radiation Syndrome) › Exposure + Contamination › Triage Guidelines › Hospital Orders Template	› Discovering an Incident › Describing an Incident › On-site Activities › Triage Guidelines › Transport Victims › Hospital Activities
Management Modifiers 	Practical Guidance 	Other Audiences 
› Radiation + Trauma › Burn Triage and Treatment › Mass Casualty › Psychological Issues › At-risk / Special Needs	› Use of Blood Products › Population Monitoring › Decontamination Procedures › Follow-up Instructions › Management of the Deceased	› First Responders › Mental Health Professionals › Hospital Staff › Public Information Officers › Radiation Safety Officers

Lay-out of Rapid Response Document

Rapid Response Actions for the Emergency Room in an Explosive Mass Casualty



Rapid Response Actions for the Emergency Department in an Explosive Mass Casualty Radiological Incident

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- ▶ Divided into:
 - ▶ Informational and descriptive narrative
 - ▶ Actions
 - ▶ Glossary
 - ▶ Step by step procedural guidelines

Germane Information and Facts

Radioactive Contamination

Fixed or Loose Contamination

- Decontamination removes loose contamination but not fixed contamination. Nat of skin cells removes fixed contamination over 2 weeks.
- Radiological decontamination almost always utilizes warm water and mild soap w the skin.
 - Hair is shampooed but hair conditioner should not be used.

Sometimes removing outer garments is referred to as dry decontamination. Dry decontam also mean using dry methods to remove contamination e.g. using a special kind of fabric w Masellu wipes on skin to remove loose contamination.

i Is it safe to work with contaminated patients?

Yes if precautions are taken

- Radiation contamination is considered a nuisance problem by radiation workers.
- Health care providers who cared for heavily contaminated first responders at Chern 1987 wore no PPE and victims were not immediately decontaminated. The max the providers working closely with contaminated patients was calculated to be app 10 millirem (mrem), or the amount of a chest x-ray.
- One condition to this is if a "hot fragment" is embedded in the patient's clothes or the external contamination is so dense that it creates a possible risk to the health c providers working in close proximity to the contaminated injured patient.

Goals for Decontamination in a Non- Mass Casualty incident

- Less than 1000 com⁴
- If level remains higher following two decontamination attempts then consider the contamination as fixed or possibly internal contamination

Goals for Decontamination in a Mass Casualty Incident

- No specific target levels are cited, perform decontamination procedures twice be Even if there is no decrease, move on to the next patient.

The following pages contain survey and decontamination guideline algorithms for non-i injured patients

⁴ Conference of Radiation Control Program Directors, Inc. Handbook for Responding to a Radiologi



Pregnancy Considerations in a Radiological Incident

A mother surviving (maternal survival) is the most important concern toward a fetus surviving (fetal survival).

- Due to the complicated clinical situation that a pregnant patient with traumatic injuries can present, radiography studies (such as X-rays) should be considered for treatment clarity, as the dose to the fetus is an acceptable risk when the mother's outcome will benefit.²³ The use of CT scans that expose the fetus to higher doses of radiation when other options are not available or acceptable should be performed when the survival of the mother or fetus is in question.
- Fetal doses due to external radiation exposure are generally less than the total dose to the mother due to the fact that the mother's abdominal and uterine walls provide shielding to the fetus.
- Fetal doses due to internal contamination are also generally less than the total dose to the mother, except in situations involving isotopes affecting the thyroid (as the fetus' thyroid is actively growing and more sensitive to iodine than an adult's thyroid) or involving isotopes collecting in the maternal bladder (due to the bladder's proximity to the fetus).
 - For internal contamination countermeasures, pregnant patients should receive priority for treatment for the prevention of long-term effects (i.e., stochastic effects) in the fetus.
- With a fetal dose below 5 rem, there is no significant risk of fetal malformation, reduced IQ or other developmental abnormality. Any pregnant patient with exposure or suspected exposure of 5 rem or greater should have specific counseling in consultation with a health physicist and maternal-fetal specialist

RADIATION DOSE TO FETUS FOLLOWING MATERNAL RADIOGRAPHY

RADIOGRAPHY EXAMINATION	ESTIMATED FETAL DOSE (rem)	COMPUTED TOMOGRAPHY EXAMINATION	ESTIMATED FETAL DOSE (rem)
Cervical Spine (AP, Lateral)	<0.0001	Head	0
Extremities	<0.0001	Chest (routine)	0.002
Chest (PA, Lateral)	0.0002	Chest (Pulmonary embolism protocol)	0.02
Thoracic Spine	0.0003	Abdomen	0.4
Abdominal (AP) 21 cm patient thickness	0.1	Abdomen and pelvis	2.5
Abdominal (AP) 33 cm patient thickness	0.3	CT angiography of the coronary arteries	0.01
Lumbar Spine (AP, lateral)	0.1	CT angiography of the aorta	3.4

Table source: Smith, Melnick, Eastin, Kitchin, Fowler, Lubner, Bhalla, and Morley. RSNA Radiographics. "Imaging of Trauma in the Pregnant Patient." May-June 2014. Volume 34, Issue 3: 750. Radiographics.rsna.org (pubs.rsna.org/doi/pdf/10.1148/rg.343135090).

²³ Smith, Melnick, Eastin, Kitchin, Fowler, Lubner, Bhalla, and Morley. RSNA Radiographics. "Imaging of Trauma in the Pregnant Patient." May-June 20



Diagnostic Assessment for Acute Radiation Syndrome and Internal Contamination

Dose reconstruction is performed by health physicists; they look at proximity to detonation and site radiation doses with contamination levels and their location on the body and physical symptoms.

[Return to Physical Findings & Patient's History Suggestive of Internal Contamination & Acute Radiation Syndrome in Patients Treated in the Emergency Department \(com\)](#)

[Return to Physical Findings & Patient's History Suggestive of Internal Contamination & Acute Radiation Syndrome in Patients Treated in the Emergency Department](#)

ASSESSMENT FOR INTERNAL CONTAMINATION

If patient is seen within 1 hour or less, collect samples from each nares and submit for radiation count

- Collect 70ml of urine for testing at CDC for radioisotope collection [\(SEE: CDC SPECIMEN COLLECTION FOR RADIOLOGICAL INCIDENTS\)](#)
- Begin 24 hour urine collection
- If possible collect fecal samples
- Consult with NYC DOHMH about laboratory that will accept clinical samples for radioisotope testing

ASSESSMENT FOR ACUTE RADIATION SYNDROME

[Return to Medical Management Algorithm](#)

- Enlist aid from:
 - NYC DOHMH, NYSDOH; REACT/S; CDC
 - Consult with NYC DOHMH about patient, isotope(s), whether to use myeloid cytokines, assisting in estimated dose
 - Hospital hematologist/intensivist; radiation oncologist; health physicist, medical physicist; Infectious Disease specialist.
- Begin serial Complete Blood Counts with differential, every 2 hours during the first 8 to 12 hours following exposure then every 4 to 6 hours for 48 hours.
 - Track the following
 - Primary cell to watch -Absolute lymphocyte count: is it decreasing?
 - Are White blood cell counts and platelet counts: are they decreasing?
- Precisely record all clinical symptoms,
 - Particularly nausea, vomiting, diarrhea, and itching, reddening or blistering of the skin.
 - Be sure to include time of onset.
 - Time to emesis can be indicative of the severity of irradiation dose (see tables below)
- Compare admission serum amylase level to one obtained at 24 hours

See tables below for more details on the assessment for Acute Radiation Syndrome.

Pertinent Procedures

GREEN/MINOR OR NON-INJURED TREATMENT AREA ACTIONS

Outside Emergency Department

- Patient should go through hospital decontamination process prior to entry into Minor Treatment Area.

Inside Green/Minor Treatment Area

- Treat minor injuries/illness,
- If patient has a significant risk for internal contamination:
 - Keep patient for ED observation for 4-6 hours prior to discharge,
 - SEE ED OBSERVATION ACTIONS
 - Notify DOHMH about patient and discuss countermeasures if available
- Have patient return if vomiting, nausea, bleeding, skin or hair changes occur over the weeks
 - Consider obtaining a CBC in 24 hrs
 - Consider repeat skin exam in 24 hrs
- Patient should have follow up exam in 2-3 weeks with CBC by primary physician



REMOVING RADIOACTIVE SHRAPNEL

Consider all open wound/s contaminated until proven otherwise.

Use appropriate radiation survey meter to evaluate and monitor the medical management of radioactive shrapnel in order to protect medical team.

Assume embedded foreign bodies will produce uptake (internal contamination).

Cover skin surrounding open wound/s (with or without foreign bodies) with water proof dressings or drapes, to limit the spread of radioactivity by water run-off during wound irrigation and decontamination.

Irrigate wound/s gently with copious amounts of water or saline.

- Multiple irrigation attempts are usually
- Remove visible radioactive foreign bodies
- While removing radioactive shrapnel, the operator and the shrapnel.

Removed foreign bodies and any instruments used

LOCALIZED SKIN DECONTAMINATION

Goal of localized skin decontamination: to decrease external contamination to a level of no more than 1000 cpm.

- Perform two decontamination cycles if feasible, with a radiation survey after each cycle.
- Use tepid decontamination water.
- Add mild soap (neutral pH) to water to emulsify and dissolve contamination.
- Direct contaminated waste-water away from patient, rather than over the rest of the body.

Use serial washcloths, gauze pads or surgical sponges to avoid recontamination.

Stop localized skin decontamination efforts after 2 decontamination cycles and handle patient with if the second radiation survey shows:

- External contamination in excess of 1,000 cpm
- Additional external decontamination efforts do not further reduce contamination levels by more than 10%

Attempts to remove all contamination from skin may not be feasible or desirable.

- Some radioactivity may be trapped in outermost layer of skin (stratum corneum) and will remain until normal sloughing occurs (12-15 days).
- Attempts at vigorous decontamination may result in loss of normal intact skin barrier and an increased risk of internal contamination.
- Cover areas of residual radiation contamination with waterproof dressings/drapes in order to limit spread of contamination to other body sites, immediate environment, and others.
- Treat focal hand contamination not removed after washing by promoting sweating, e.g., put a hand in a surgical glove for a few hours.

Persistently elevated levels of external contamination after adequate decontamination may also be due to:

- Internal contamination
- Retained radioactive foreign bodies (radioactive shrapnel)
- Contaminated wounds
- Contaminated orifices

Managing Open Wounds

Consider all open wounds contaminated until proven otherwise

Assume significant wound contamination will produce uptake (internal contamination)

- Attempt to prevent or minimize further uptake of radioactive material into the body

Cover skin surrounding open wounds (with or without foreign bodies) with waterproof dressings or drapes. This will limit the spread of radioactivity by water run-off during irrigation/decontamination. See Figures 2 and 3

Irrigate wound(s) gently with copious amounts of saline or water. See Figures 5 and 6

Monitor wound(s) with radiation survey meters (radiation detectors) before irrigation and after each irrigation attempt and record results. See Figure 4

- Gently swab wound(s) with sterile cotton-tipped applicator and survey the cotton tip for levels of radioactivity.
- If monitoring wound(s) directly, remove contaminated drapes, dressings, etc. before conducting survey.

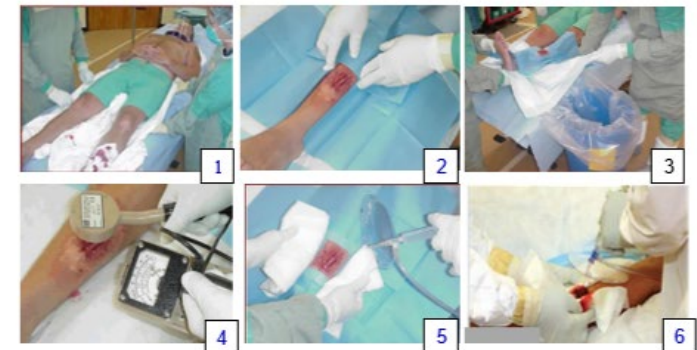
If contamination levels remain high after primary irrigation attempts, consider conventional surgical debridement of wound(s)

- Obtain expert medical and health physics advice before excision of vital tissue.
- Surgically removed tissue and all surgical supplies should be stored properly and labeled by RSO for forensic evaluation and proper disposal.

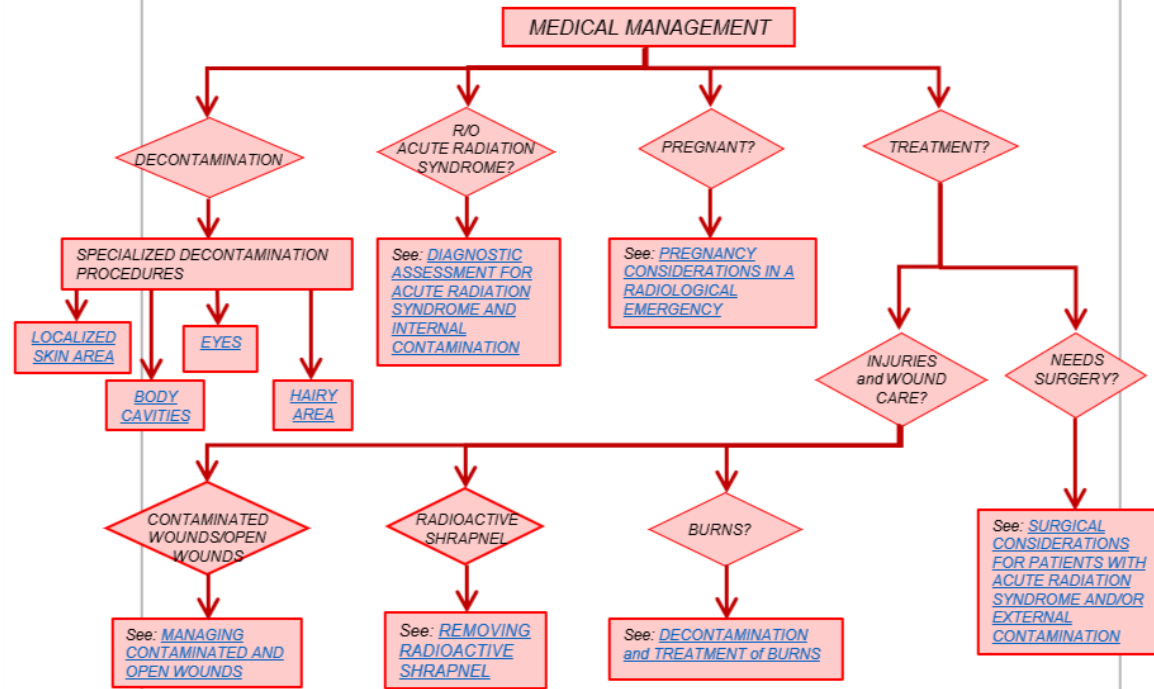
Cover decontaminated wounds with a waterproof dressing to prevent further contamination.

Decontaminate skin around wounds as thoroughly as possible before suturing or other treatment.

Decontaminate intact skin as described in Localized Skin Decontamination



Medical Management Including Specialized Decontamination and Injury Care



For patients needing surgery:

Treat all life threatening injuries immediately following current standards of care; any radioactive contamination or radiation injuries are secondary

- If radiation burns are suspected – avoid central/parenteral access in that area if possible

Labwork: send a CBC with differential as soon as possible- obtain an absolute lymphocyte count

- Include **serum amylase** with routine clinical samples

Type and crossmatch for blood products if needed²⁰

- Order **irradiated** blood products for all types of transfusion cells
- Order **leukoreduction** of all blood products **except WBC**

Enlist aid of radiation medicine expert to obtain cursory total exposure dose

Initiate early use of granulocyte stimulating cytokine therapy if appropriate

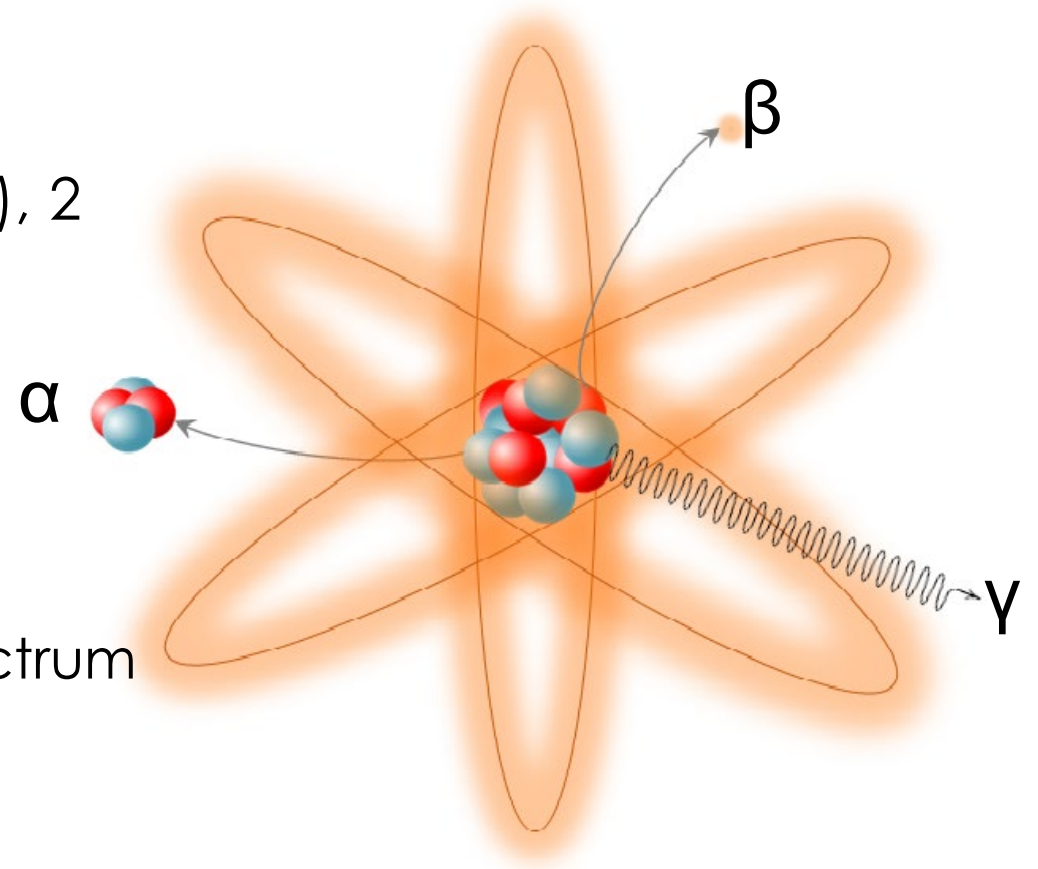
- Consult with hematologist or radiation medicine expert

Proceed with surgery within 48 hours of exposure if patient is suspected to have 1 Gray or higher exposure

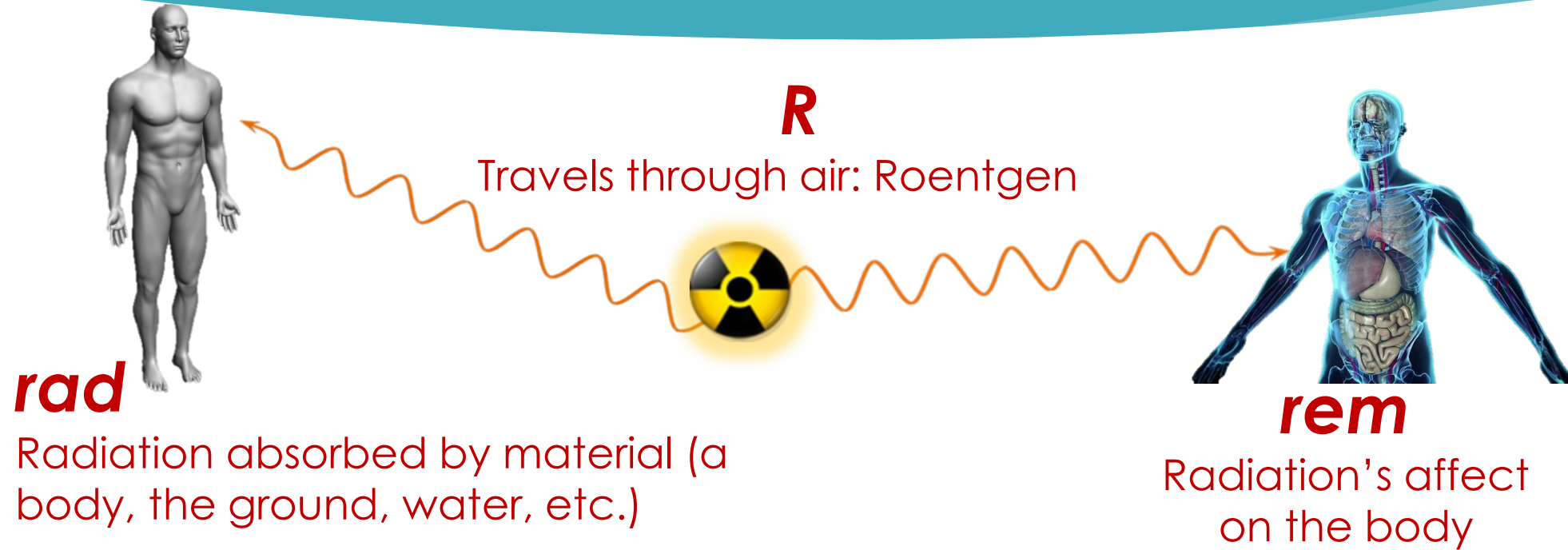
Actions and Algorithms

Radiation Refresher- Radiation

- ▶ Energy released from the nucleus of a radioactive atom due to imbalance in the forces within the nucleus
 - ▶ Releases energy as ionizing radiation (IR), 2 types of IR
 - ▶ Particle
 - ▶ Mass & energy; charged
 - ▶ Alpha/beta/neutrons
 - ▶ Photon
 - ▶ Pure energy; electromagnetic spectrum
 - ▶ Gamma radiation; X-rays



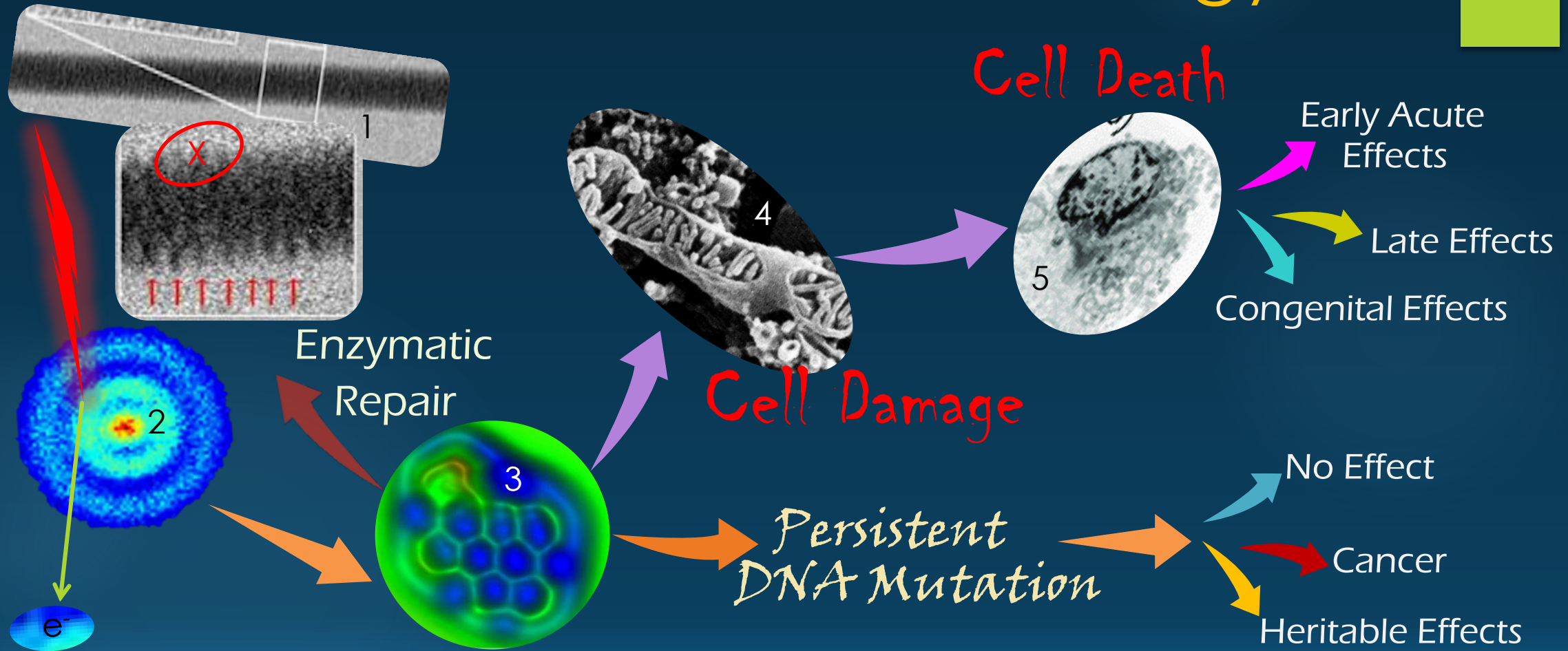
Radiation Refresher- Units



For Beta & Gamma radiation **$R = rad = rem$**

For Alpha radiation **$R = rad = 20 rem$**

Radiation Refresher Radiobiology



1: Enzo di Fabrizio et al. 'Direct Imaging of DNA Fibers: The Visage of Double Helix'. <http://pubs.acs.org/doi/abs/10.1021/nl3039162//>

2: <http://physicsworld.com/cws/article/news/2013/may/23/quantum-microscope-peers-into-the-hydrogen-atom>

3: <https://phys.org/news/2012-09-world-atomic-microscope-chemical-bonds.html>

4: Source is Tanaka, Eukaryotes: Scanning Electron Microscopy of Intracellular Structures, Intl. Rev. Cytology, Supplement 17, 1987, pp89-120

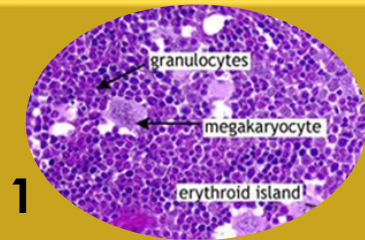
5: https://www.researchgate.net/profile/Fadaka_Adeiwale_Oluwaseun/publication/322364637/figure/fig3/AS:581247890935808@1515591704441/Types-of-cell-death-and-their-morphological-hallmarks-Diagrammatic-classification-of.png//

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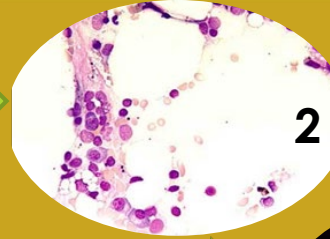
Radiation Refresher- Radiobiology

Cell
Death

Early Acute
Effects

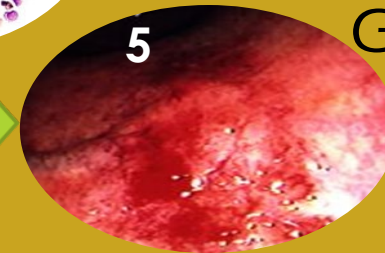
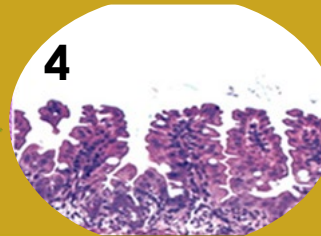


300 rem



Hematopoietic Syndrome

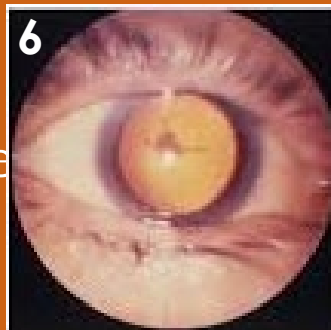
1000 rem



Gastrointestinal
Syndrome

Late Effects

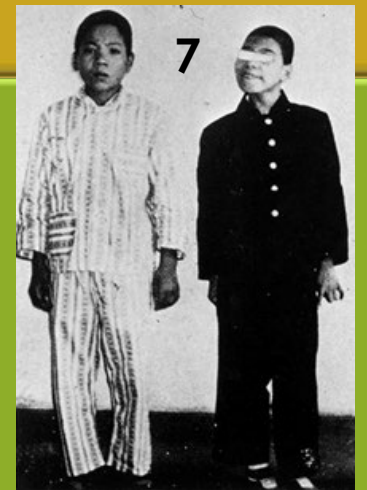
Posterior Capsule
Cataract



Cell
Death

Congenital
Effects

In utero
exposure



1: Irradiated bone marrow: http://archive.ahra.gov/research/pedprep/pedfig6_4.

3, 4: Lt slide: copyright tPathOut@gmail. Rt slide: Wenlin Deng , Mary Jane Viar , Leonard R. Johnson. 'Polyamine depletion inhibits irradiation-induced apoptosis in intestinal epithelia.' American Journal of Physiology - Gastrointestinal and Liver Physiology Published 1 September 2005 **Vol.** 289 **no.** 3, G599-G606 **DOI:** 10.1152/ajpgi.00564.2004

5: Rajeev Vasudeva, MD, FACG; Chief Editor: Julian Katz, MD. 'Intestinal Radiation Injury'. <http://emedicine.medscape.com/article/180084-overview>

6: <https://slideplayer.com/slide/276951/data:image/jpeg;base64/9j>

7: [aasc.ucla.edu. cab/200708230012.html](http://aasc.ucla.edu/cab/200708230012.html).

Modes of Exposure

EXTERNAL EXPOSURE



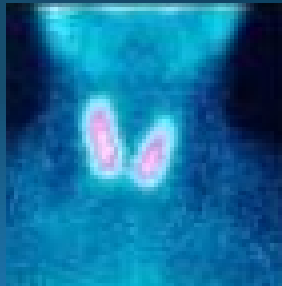
- Penetrating radiation
- External source
- Person **does not** emit radiation

EXTERNAL CONTAMINATION



- Radioactive material (e.g., liquid, powder, metal fragments or dust) contamination on the body and clothes
- Once removed then rad source is gone
- Contamination on person **may** emit radiation

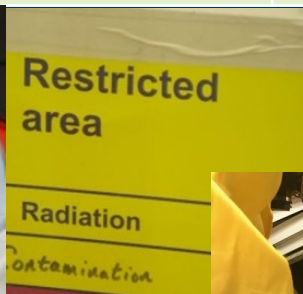
INTERNAL CONTAMINATION



- Radioactive material (e.g., liquid, powder, metal fragments or dust) contaminating the inside body
- Continuous source of radioactive emissions until decays/excreted
- Certain treatments (countermeasures) expedite excretion
- Person **may** emit radiation

Preparing Staff and Facility

E	D	P	R	E	P	S	S
EQUIPMENT	DOSIMETRY	PPE	RADIATION CONTROL AREAS	EXPERTS	PADS	SURGE	SURVEY, Survey, Survey



<http://in.bgu.ac.il>



Courtesy Elston Stephenson

Courtesy of IAEA

Standard of Care

In order, the treatment priorities are:

(1) Ensure the safety of the emergency responders & staff

(2) Evaluate and treat patients with life-threatening injuries prior to any radiological issues (i.e. decontamination)

Patient care should proceed as usual and not be affected by contamination

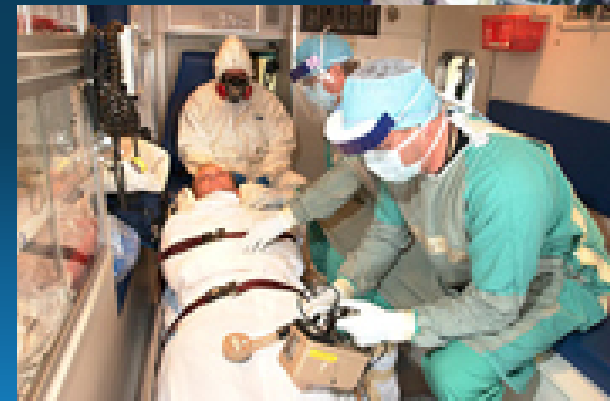
“Contamination levels will likely be low or nuisance contamination”

Working Safely with Contaminated Patients

- ▶ Decrease exposure using time & distance; possibly shielding
- ▶ Wear PPE (standard precautions) and dosimeter
- ▶ Removing patient's clothes decreases contamination levels 80 to 90%
 - ▶ Outside of ED if practical – yellow/green tagged (maybe red tagged)
- ▶ Engage RSO to survey patient
- ▶ ***All wounds presumed contaminated***



Courtesy of OSHA



Courtesy of
Health Physics
Society

Explosive Injuries

PRIMARY: Injury from a highly pressurized blast wave that moves through the patient's body and organs

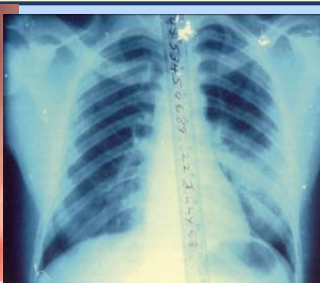
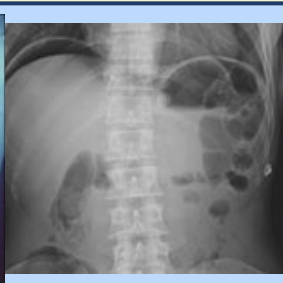
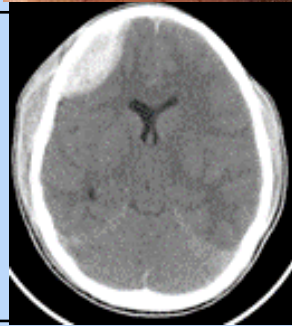
SECONDARY: Injury from a blast wave that drives explosion debris, such as shrapnel, into a patient



TERTIARY: Injury caused by the patient propelled through the air.

Reprinted with permission from Macmillan Publishers Ltd: *Journal of Cerebral Blood Flow and Metabolism*, Cernak and Noble-Haeusslein, copyright 2010.

Radiological Complications with Explosive Injuries

EFFECT	IMPACT	INJURIES	
PRIMARY	Blast Lung, perforated eardrum, perforated bowel, concussions (MTBI)	  	Consider ARS with severe trauma
SECONDARY	Traumatic amputations, lacerations, retained shrapnel, eye injuries	 	Wounds with radioactively contaminated debris
TERTIARY	Blunt trauma, fractures, traumatic amputations, Traumatic Brain Injuries,	 	Wounds with radioactively contaminated debris, possible ARS
QUATERNARY	Burns, inhalational Injury, crush injuries, radiation injuries	 	Wounds with radioactively contaminated debris, possible ARS

Radiological Incident Injuries

- ▶ Fatalities and injuries will be from the *explosion*
- ▶ Radiation exposure and dose depend on:
 - ▶ Proximity to device
 - ▶ Those closer to point of detonation will have higher degree of injuries and heavier contamination
 - ▶ Type and quantity of radioisotope
 - ▶ There are 31 isotopes of “concern”
 - ▶ Americium-241; Cesium- 137; Cobalt- 60; Plutonium -238

Radiation Disease

▶ Acute Radiation Illness

▶ Consists of 4 stages:

PRODROME	LATENT	MANIFEST ILLNESS	RECOVERY/DEATH
Min - 48 hrs	Days- 6 wks	Days to 60 days	Days - 60 days

▶ Traditionally described in dose dependent subsyndromes

- ▶ Hematopoietic (loss of bone marrow) onset 75 rems;
- ▶ Gastrointestinal (denuding of the intestine) onset > 600 rems
- ▶ Cardiovascular- Central Nervous System (shock/coma) > 1000 rems

▶ Currently thinking in terms of multi-organ failure

Toka-Imura Criticality Accident 9.30.1999

TIME	EVENTS	TIME after ACCIDENT	Symptoms			
			Worker A		Worker B	Worker C
			Nausea/ Vomiting	Diarrhea	Nausea/ Vomiting	Nausea
10:35	Accident	0				
10:43	Ambulance called	8		● Loss of Consciousness		
10:46	Ambulance arrives	11				
11:27	Workers on ambulance	52		● High Fever		
11:49	Ambulance leaves	74				
12:07	Arrives Hospital	92				
14:16	Transferred	188				

Ball-Park Exposure Dose Using Prodromal Signs and Symptoms

Signs and Symptoms	100 - 200 rem	200 – 400 rem	400 - 600 Rem	600 - 800 rem	> 800 rem
Nausea/ Vomiting	10 - 50%	70 - 90%	100%	100%	100%
Onset	> 4 hours	< 4 hours	< 1 hour	< 30 min	< 10 min
Diarrhea	None	None	Mild	Heavy	Heavy to profuse
Onset	-----	-----	3-8 hrs	1-3 hrs	Mins to < 1 hour
Incidence	-----	-----	< 10%	> 10%	~ 100%
Headache	Slight	Mild	Moderate onset 4-24 hrs	Severe onset 4 hrs	Severe within 1 hr
Consciousness	Awake	Awake	Awake	Arousable	LOC within min
Body Temp		Low grade	Fever	High fever	High fever
Medical response	Outpatient	Admission	Aggressive treatment	Aggressive treatment	Palliative

Upside Down Triage

Last to arrive: Critical/Red Tag
Contamination/ ARS/ Internal Contamination



Triage, immediate survey and care, decon when stable

Next to arrive: Serious Injuries /Yellow Tags
Contaminated/ Internal Contamination



Triage,
Screen/decon;
care can be delayed,
mental health care



First patients to arrive: Worried
Well/ Minor Injuries /Green Tags/
Possible Contamination



1. Screening
2. Decontamination
3. Care can be delayed
4. Probable large mental health care

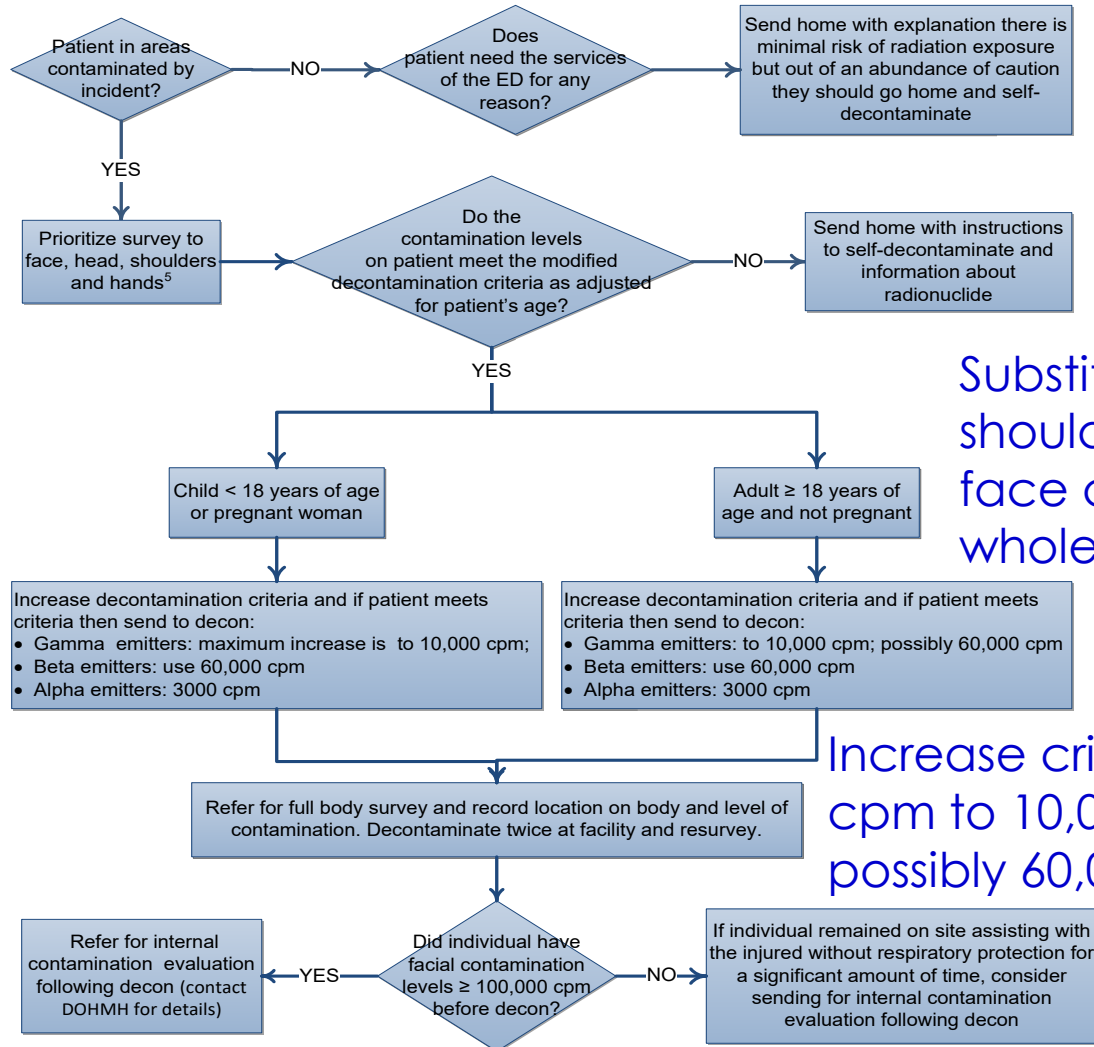
Management of the Non-Injured

- ▶ To manage worried well: Advise setting-up screening/decontamination
 - ▶ Follow Hospital Plan
 - ▶ This should be hospital administrator's task



www.mc.vanderbilt.edu/reporter

Modification of Decontamination Guidelines For
NON-INJURED PATIENTS in a Mass Casualty Event⁴



Can the patient travel to a CRC?

Substitute survey of shoulders, neck, head, face and hands for whole body

Increase criteria from 1000 cpm to 10,000 cpm or possibly 60,000 cpm

Modification of Decontamination Criteria in a Mass Casualty RDD

Red Emergent Actions

► *Treat life threatening injuries without regard to contamination*

➤ Always have a cursory radiological survey done

➤ Remove clothing

➤ Enlist the aid of experts

➤ If suspect ARS, recruit hematologist/radiation oncologist

➤ Bring surgeon into discussion about surgery on a contaminated patient



Treatment for Acute Radiation Syndrome, Internal Contamination and Cutaneous Radiological Injury

Early Management of ARS¹²

1. ED Physician *may need* to be responsible for the following in consultation with specialist:
 - a. Order the administration of:
 - i. Antibiotic, antiviral, and antifungal agents
 - ii. Early cytokine therapy
 1. Filgrastim (Neupogen®), Pegfilgrastim (Neulasta®) and Sargramostim (Leukine®) for the Hematopoietic Syndrome of ARS: stimulates the production of white blood cells to decrease neutropenic nadir and duration.
 - iii. 5 hydroxytryptamine or serotonin antagonists for nausea
 - b. Early wound closure; see [MANAGING OPEN WOUNDS](#).
 - i. Usual standards of care for wound closures are applicable¹².
2. Enlist Infectious Disease Control Officer to institute the following¹³:
 - a. Barrier isolation
 - b. Reverse isolation for patients with whole body doses greater than 2-3 Gy
 - c. Strict environmental control, including isolation, strict hand washing, surgical scrubs and masks for staff, and possibly laminar flow

Radiological Procedures and Fetal Exposure

RADIOGRAPHY EXAMINATION	ESTIMATED FETAL DOSE (rem)	COMPUTED TOMOGRAPHY EXAMINATION	ESTIMATED FETAL DOSE (rem)
Cervical Spine (AP, Lateral)	<0.0001	Head	0
Extremities	<0.0001	Chest (routine)	0.002
Chest (PA, Lateral)	0.0002	Chest (Pulmonary embolism protocol)	0.02
Thoracic Spine	0.0003	Abdomen	0.4
Abdominal (AP) 21 cm patient thickness	0.1	Abdomen and pelvis	2.5
Abdominal (AP) 33 cm patient thickness	0.3	CT angiography of the coronary arteries	0.01
Lumbar Spine (AP, lateral)	0.1	CT angiography of the aorta	3.4

Non-cancer health effects *are not* detectable with acute exposures less than 5 rads

<https://emergency.cdc.gov/radiation/prenatalphysician.asp>

Table source: Raptis, Mellnick, Raptis, Kitchin, Fowler, Lubner, Bhalla, and Menias. RSNA *RadioGraphics*, "Imaging of Trauma in the Pregnant Patient." May-June 2014. Volume 34, Issue 3: 750. Radiographics.rsna.org (pubs.rsna.org/doi/pdf/10.1148/rg.343135090).

Yellow (Urgent) Actions

**YELLOW/
URGENT**

Conduct a radiological
body survey as thoroughly
as feasible SEE:
CONDUCTING A
RADIOLOGICAL SURVEY
OF PATIENTS

Before entering ED,
decontaminate as
thoroughly as possible

Rapid Response Actions for the Emergency Room in an Explosive Mass Casualty

DECONTAMINATION of STABLE NON-AMBULATORY PATIENTS TABLE of ACTIONS

See Algorithm
All clothing should be removed from patient and equipment
➤ Avoid contaminating the mouth and nose
➤ Cut clothing down center of chest and roll away from face and out from under patient
➤ Secure clothing as radioactive contamination
Consider designating stretchers to be "FOR DECONTAMINATION ONLY"
The patient on the stretcher or wheelchair should then be rolled with assistance through the shower and decontaminated
➤ Health Care providers in PPE should actively wash the patients with particular concern to decontaminate underneath the patient
➤ Decontaminate stretcher or wheelchair simultaneously
Dry patient and transfer to a clean stretcher or wheel chair and cover in clean sheets or gown/scrubs as indicated
Staff decontaminates prosthetics, ambulatory assistance devices and wheelchairs
➤ Return to patient if decontamination attempts are successful
➤ If contamination count remains persistently above 1000 cpm the discuss with Health y-or Medical Physicist
Perform post-decontamination radiological survey



YELLOW/URGENT TREATMENT AREA ACTIONS

Outside Emergency Department
➤ Patient should go through hospital decontamination process prior to entry into Urgent Treatment Area.
Inside Yellow/Urgent Treatment Area
➤ Treat injuries/illness,
➤ Obtain 1st CBC,
➤ Determine risk of internal contamination, ○ Observe up to 6 hours after event for nausea or vomiting ○ Obtain second CBCs 4-6 hrs after 1st ○ Use results to determine total lymphocyte count and lymphocyte depletion ○ Obtain spot urine for bioassay if requested by public health
➤ If patient is admitted begin work up for potential ARS ○ serial CBCs q 6 hr X 48 hr, ○ serum amylase, ○ HCG ○ Use results of CBCs to determine total lymphocyte count and lymphocyte depletion ○ Begin 24 hour urine collection for possible bioassay if requested by DOHMH ○ Note times and onset of prodromal symptoms if they occur
➤ Notify DOHMH about patient and discuss countermeasures if available.



6

3

Irrigation and Debridement of Contaminated Wounds



Monitor wounds with radiation detector before irrigation and after each irrigation attempt



Cover skin surrounding open wounds with waterproof drapes



Set-up drapes to allow irrigation fluid to run-off into a lined bucket



Irrigate with copious amounts of sterile water or saline

- Swab wound with sterile cotton tipped applicator , measure level of radioactivity
- If monitor directly remove drapes

1. If contamination levels remain high, consider conventional surgical debridement
2. Obtain expert medical/health physics advice before excision of vital tissues
3. Any excised tissue must be properly labeled radioactive and stored for possible forensic evaluation

Resources

- ▶ NYC Dept of Health and Mental Hygiene:
<https://www1.nyc.gov/site/doh/providers/emergency-prep/hospitals.page>
- ▶ New York State Department of Health:
<https://www.health.ny.gov/environmental/radiological/radon/emergency.htm>
- ▶ REMM: Radiation Emergency Medical Management
<https://www.remm.nlm.gov/>
- ▶ Radiation Emergency Assistance Center and Training Site
REAC/TS: <https://orise.orau.gov/reacts/>
- ▶ CDC: <https://emergency.cdc.gov/radiation/>

The End

