



The Augmented Role of the Medical Physicist in Radiation Emergencies

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President AOARP, Past President ARPS

What do I mean by augmented role?

- Emergency preparedness and response is not always at the forefront of the MP mind
- Day to day activities can create a sense of sameness

What do I mean by augmented role?

- The augmented role for emergency response requires a shift in mindset
- It requires a constant background awareness that at any time the MP can be called upon to provide crucial support during a radiation emergency

Defining the discussion

- There will be things that a medical physicist (MP) can influence and things they cannot.
- By deciding upon the boundaries of influence it is possible to address concepts of radiological emergency response into manageable pieces.
- This presentation focusses on what the MP can do within the hospital environment.

Emergency Response Fundamentals

PPRR

- Prevention – MP unable to influence
- Preparedness – MP able to influence hospital
- Response – MP able to influence hospital
- Recovery – MP able to influence hospital

What can an MP encounter?

- Emergency Departments are designed to deal with anything that walks through the front door.
- Radiological emergencies have happened and will happen.

The Radiological Accident in Goiânia



NORTHERN TERRITORY NEWS

Phone 8244 1800 CRAWFORD 0441 0000

NEWS

Darwin Tuesday, February 17, 1988

ELLE'S BABY ... IT'S A BOY: P3

U2 SUPERGROUP'S TRIBUTE TO HUTCHENCE ON TOUR

JAPANESE PILOT ARRESTED IN DARWIN

FOR THE WAY WE WERE PAGE 23

DEADLY TOXIN SCARE FOR CITY

Deadly package ... fire officers inspect the parcel containing the chemical iodine at Berninah yesterday. Picture: KELLIE BLOCK

Box sparks road blocks

By MICHELLE WALCZAK

A deadly box of radioactive chemicals stopped afternoon traffic at Darwin's busiest intersection yesterday.

Traffic came to a standstill as police sealed a 20m area around the Berninah block-out. They inspected the box on the lanes of the Stuart Hwy.

The alarm was raised ... Senior Sergeant Steve ... Police said the man ...

left his car after hitting who co-ordinated the package, then moved the package to the gutter on the city side of the intersection, the contacted police of a title finger nail.

The motorist was later taken to hospital for observation and last night had not suffered any side effects.

He said it was necessary to take full precautions until it was established whether the Territory Health Service radiation health parcel had leaked.

Mr Cassin said ... The airport ... could kill ...

Win big \$\$\$ in new Post game PAGES 2 & 22

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TV: Page 32

NEW YORK POST

WEDNESDAY, MARCH 28, 1979 15 CENTS

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A-PLANT MISHAP LEAKS RADIATION

Contaminated steam escapes in Pa.



HARRISBURG, Pa. — The cooling system of a nuclear power plant on the Susquehanna River broke down today, leaking radiation into the air at what was probably the nation's most serious nuclear reactor accident to date.

A small amount of radioactive steam escaped from the Three Mile Island plant, triggering an automatic shutdown and forcing evacuation of the facility.

No injuries were reported and authorities said the leak was not as serious as the worst nuclear power plant accident in the world.



BREAKING NEWS

RADIATION DETECTED

Agency says the detection indicates that some of the nuclear fuel at the reactor

Scale of Plans ?



1. Transport accident involving radioactive material



4. Fire incident involving a premise containing or a vehicle transporting radioactive material



2. Loss and theft of radioactive material



5. Explosion of a dirty bomb
















3. Finding of suspected radioactive material



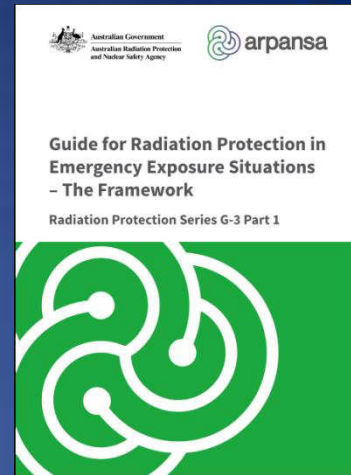
6. Incident response to nuclear threats (direct and consequence management)

Type of radiation emergency	Emergency preparedness category	Potential for health effects related to radiation			Potential for health effects related to emergency			Potential number of people involved	
		Tissue reactions	Stochastic effects	Contaminated persons	Conventional trauma	Psychological localised	Psychological widespread	Limited	Large
Improvised nuclear device	Cat IV	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Reactor (OPAL)	Cat II	Possible	Possible	Possible	Possible	Yes	Yes	Yes	Possible
Reactor (NPW)	Cat V, with conditions of Cat I or II	Possible	Possible	Possible	Possible	Yes	Yes	Yes	Possible
Criticality	Cat III or IV	Possible	No	Possible	Possible	Yes	Possible	Yes	No
Radioisotope thermoelectric generators	Cat IV	Possible	No	Possible	No	Yes	Possible	Yes	Possible
Lost or stolen radioactive material	Cat IV	Possible	No	Possible	No	Yes	Possible	Possible	Possible
Misuse of industrial radioactive material	Cat IV	Possible	Possible	Possible	No	Yes	Possible	Yes	Possible
Transport/laboratory	Cat IV	No	No	Possible	Possible	Yes	No	Yes	No
Malicious use of radioactive material	Cat IV	Possible	Possible	Possible	Possible	Yes	Yes	Yes	Yes

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Reactor (NPW)	Cat V, with conditions of Cat I or II	Possible 	Possible 	Possible	Possible	Yes	Yes	Yes	Possible
Criticality	Cat III or IV	Possible 	No	Possible	Possible	Yes	Possible	Yes	No
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Lost or stolen radioactive material	Cat IV	Possible 	No	Possible	No	Yes	Possible	Possible	Possible
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Transport/laboratory	Cat IV	No	No	Possible	Possible	Yes	No	Yes	No
Malicious use of radioactive material 	Cat IV	Possible 	Possible 	Possible	Possible	Yes	Yes	Yes	Yes

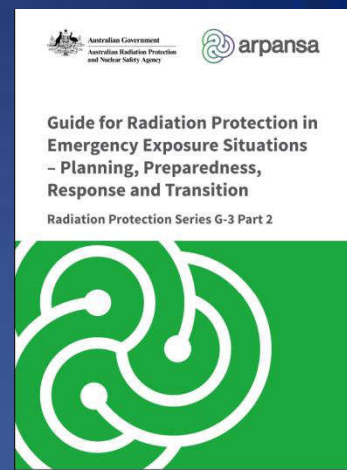
Framework provided by national health authorities (1)

- At the national level, the response to a nuclear or radiological emergency is integrated in a national emergency response plan.
- This framework ensures that planning for medical responses to nuclear or radiological emergencies exists, and hospitals that manage the medical consequences have staff trained in the necessary skills.



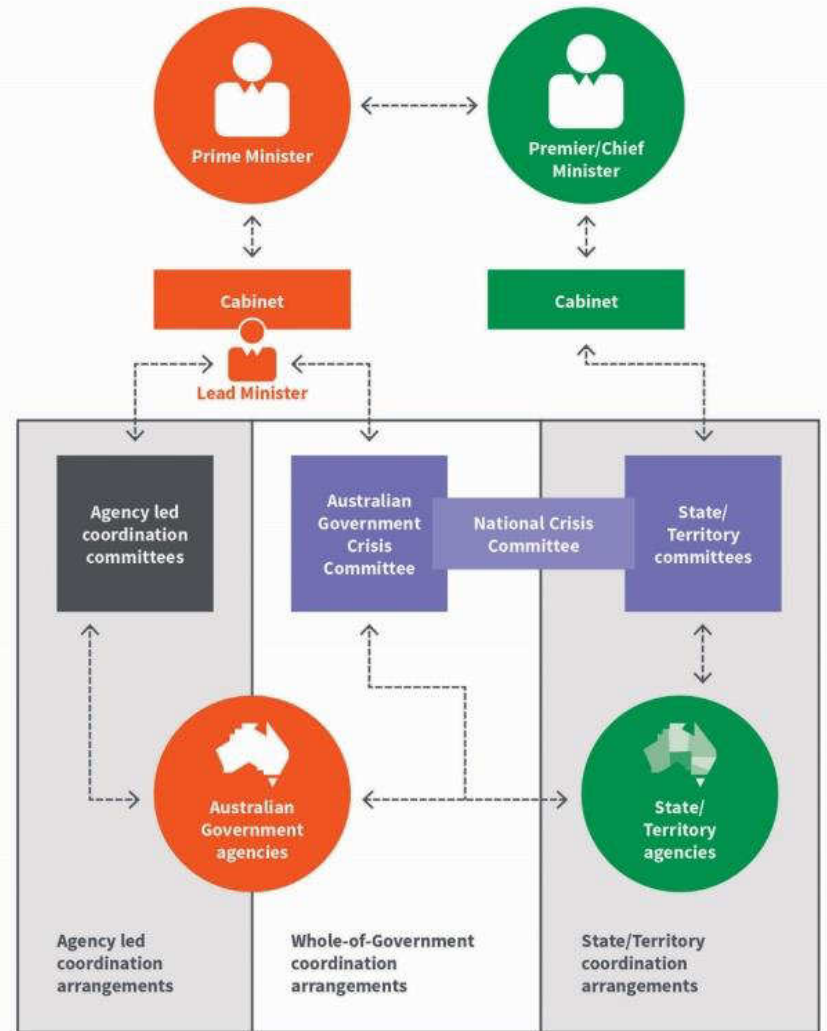
Framework provided by national health authorities (2)

- This preparedness also includes the development of guidance and protocols, exercises, and drills to prepare the facility and staff to respond to emergency scenarios.
- These exercises need to be performed with appropriate regularity in order to train staff and provide an effective response if an emergency occurs.



Aussie example (AE):

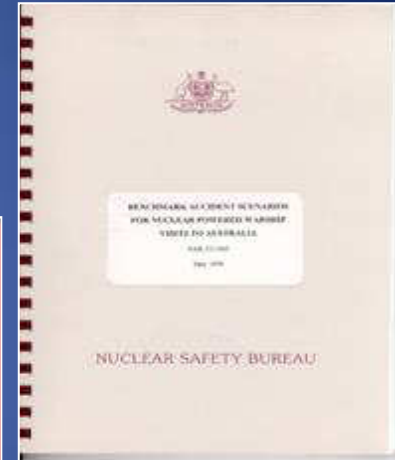
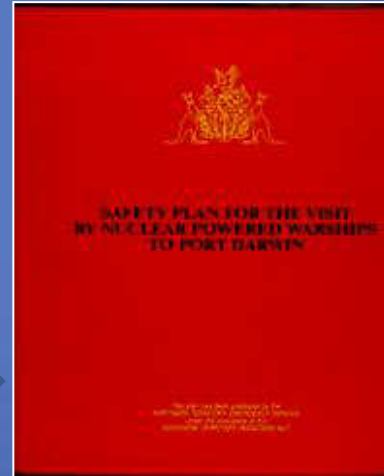
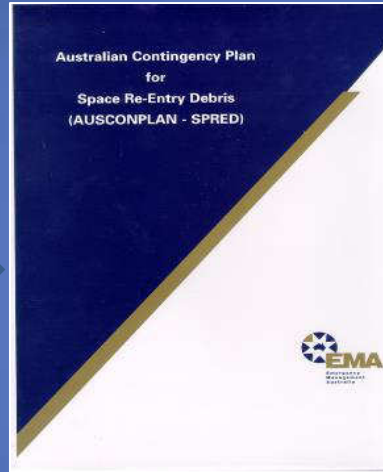
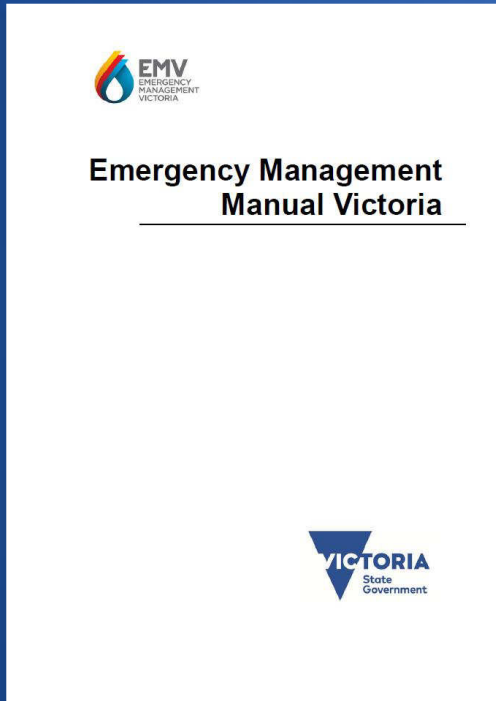
- Commonwealth & State Plans require smooth integration where multi-level Governments are involved.



AE: National Plans and Arrangements

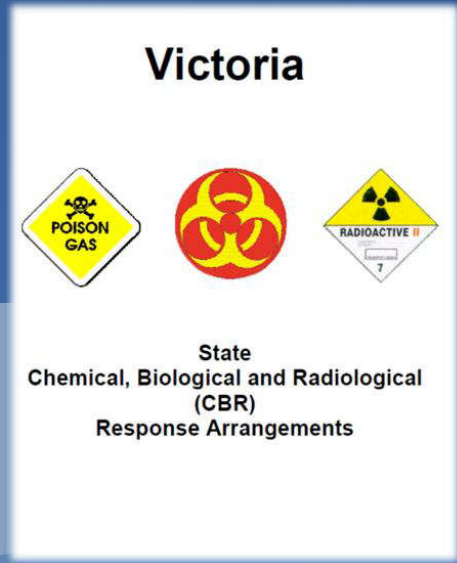
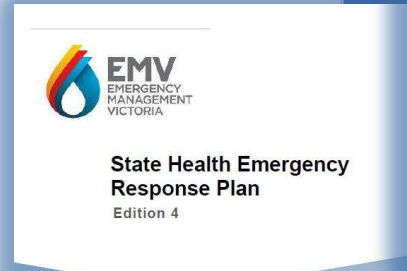
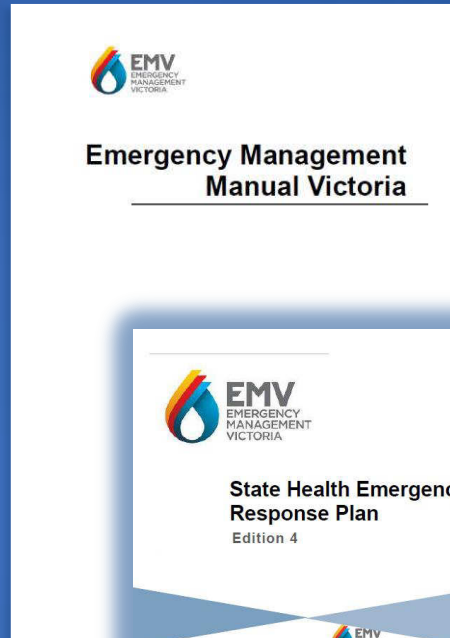
- National Strategic and Special Events (NSSE)
- Accident/Misuse of RN Material (COMDISPLAN)
- Radiological/Nuclear Terrorism (NCTP)
- Nuclear Powered Warships (OPSMAN1)
- Space Debris Re-entry (AUSCONPLAN SPRED)
- CBRN Response Plan (Health CBRN Plan)

AE: State Assistance & Coordination



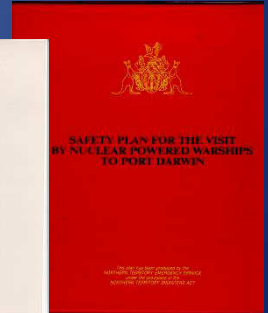
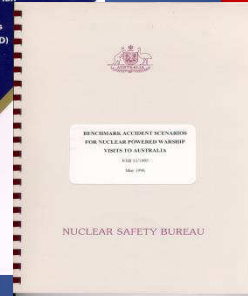
AE: State Plans

- State Government Agency roles and responsibilities are defined via the Emergency Management Manuals



AE: Specific Responsibilities

- HAZRAD Events - loss of control
- NPW Visits to Victoria (NPW PORT SAFETY PLAN)
- Planning for Potential Re-Entry of Radioactive Space Debris (AUSCONSPLANSURED)



Radiation Emergency Response Roles

- Health – Control agency for radiation
- Health - State Health Emergency Response Plan to ensure an effective medical response
- Ambulance – first aid & transport
- Fire – victim extraction & decon



Radiation Emergency Response Roles

- **Hospitals – Treat contaminated and/or injured**
- Police – coordinate scene security
- Forensics – evidence where criminal activity suspected
- Transport – trains, trams, cars, people
- Coroner – manage bodies/investigate

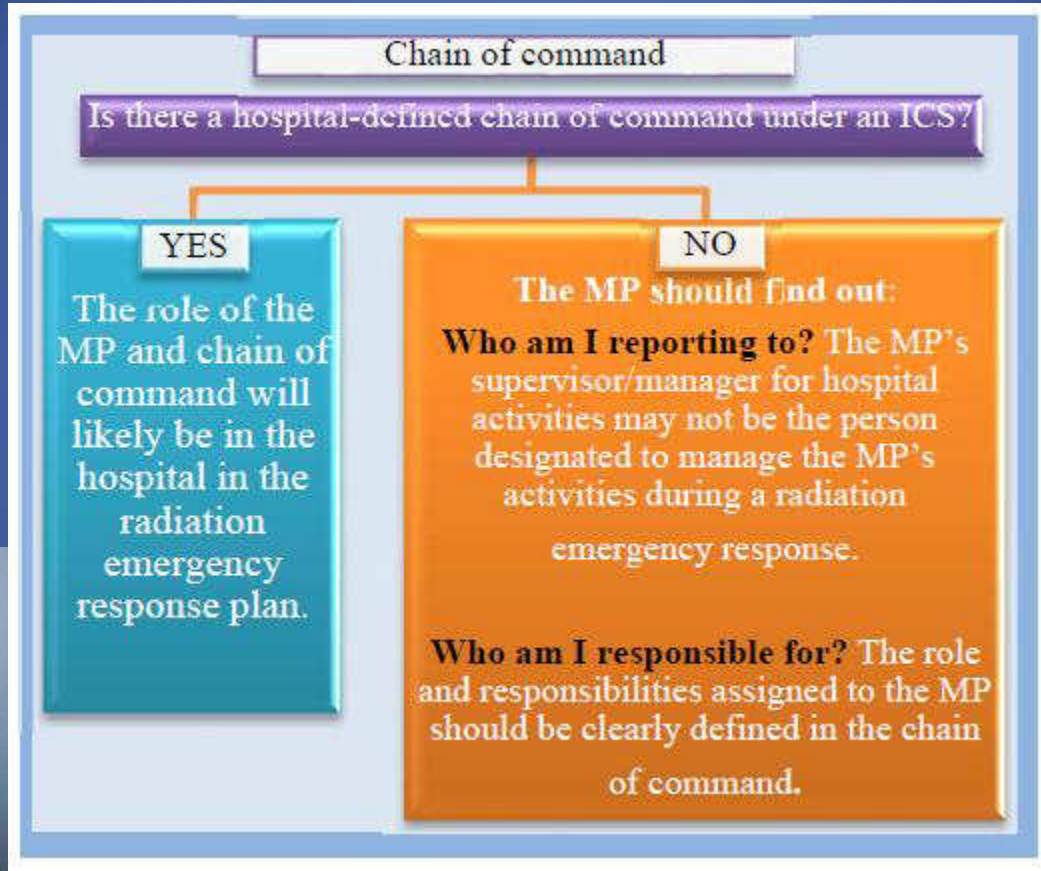


The MP in a radiological emergency

- MP understands radiation protection
- MP is experienced in dose assessment
- MP handles radioactive material
- MP assesses exposure in a hospital environment



Know your chain of command



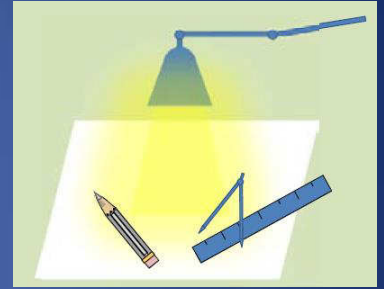
Roles of MP in a radiological emergency (1)

- Radiological assessor (RA): As a qualified expert in radiation dosimetry, the MP can fulfil the function of an RA
- This role bridges preparedness and response.



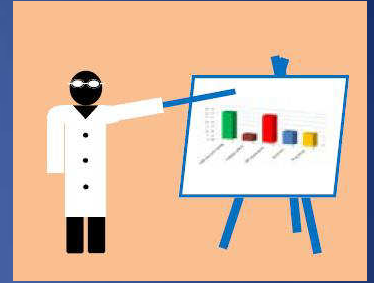
Roles of MP in a radiological emergency (2)

- Scientific and technical advisor: Because the MP usually acts as a radiation protection officer, he or she can give advice on matters related to a nuclear or radiological emergency.
- This role bridges preparedness and response.



Roles of MP in a radiological emergency (3)

- Trainer in radiation protection: MP typically provides regular training in the clinical environment. Those MPs who are specifically trained in nuclear or radiological emergencies can perform training inside and outside their hospital. During the emergency, the trainer will be able to provide quick briefings on radiation protections for the emergency teams.



Framework of collaboration

- Pre-Hospital Level – triage and decontamination
- Hospital Level – provide information and training to all medical staff
- It is essential to integrate the MP into the preparedness stage in order to define their roles and actions in the planning at local, regional and national levels.

Routine activities support the medical response: preparedness

- Dose assessment (for clinical purposes);
- Radiological surveys using radiation detection instrumentation in the hospital environment;
- Screening of contamination. Some MPs may have experience in the decontamination of patients (i.e. those related to NM departments);
- Training of other personnel in radiation protection;
- Role as Radiation Advisor at the hospital level

Training: preparedness

- Successful response depends on successful training before a response is needed.
- Understanding potential exposure pathways both for health protection and contamination control within the hospital is essential.

Thinking exposure: preparedness

External

- whole body, partial or localized
- Skin, hair, nails, clothes
- workers, response personnel, public

Preparation

- Survey and contamination meters

Thinking Contamination: preparedness

External:

- clothes, hands, feet, face, skin, hair

Internal:

- lungs, body orifices, mouth, nasal passages, wounds

Preparation:

- nasal and oral swabs, plastic bags, ID tags, recording sheets

Preparedness: radiation does not cause...

- Immediate death
- Immediate burns
- Immediate wounds
- Sudden incapacitation (rarely with extremely high dose)
- Irradiation or contamination alone are NOT medical emergencies

Thinking PPE

- Gown and waterproof apron
- Cap
- Waterproof shoe covers
- Two pairs of gloves, the inner pair taped to the gown, the outer pair to remove and replace as indicated
- Surgical mask
- Eye protection
- Personal radiation dosimeters

Note: lead aprons do not provide sufficient shielding from gamma radiation and are only indicated for usual clinical x-rays



Protecting staff: preparedness

Dose Rate	Time to receive 1 mSv	Time to receive 20 mSv
1 μ Sv/hour	41 days	2 years 3 months
10 μ Sv/hour	4 days 4 hours	83 days
100 μ Sv/hour	10 hours	8 days 8 hours
1 mSv/hour	1 hour	20 hours
10 mSv/hour	6 minutes	2 hours
50 mSv/hour	1 minute	24 minutes
100 mSv/hour	-	12 minutes

IMPORTANT!

Medical emergency care is the most important activity. Stabilizing a patient with life-threatening conditions should **NOT** be delayed because of the presence of contamination.

The only survivors of a radiation accident who have been so badly contaminated as to be a threat to those involved in treating them were...in...Chernobyl. No other accident victims, including those at Goiânia, Brazil, where gross contamination...occurred, have presented any threat to responders, due to the precautions...they followed...

Guidance Manual: Medical Management of Individuals Involved in Radiation Accidents, Technical report Series No. 131, Australian Radiation Protection and Nuclear Safety Agency, August 2000

Protecting staff: preparedness

Tasks	Guidance value*		
	$H_p(10)$ **	E ***	AD_{T+}
	<500 mSv	<500 mSv	$<\frac{1}{2}AD_{T,Table\ 2}$
Life-saving actions	This value may be exceeded — with due consideration of the generic criteria in Table 2 — under circumstances in which the expected benefits to others clearly outweigh the emergency worker's own health risks, and the emergency worker volunteers to take the action and understands and accepts these health risks		
Actions to prevent severe deterministic effects and actions to prevent the development of catastrophic conditions that could significantly affect people and the environment	<500 mSv	<500 mSv	$<\frac{1}{2}AD_{T,Table\ 2}$
Actions to avert a large collective dose	<100 mSv	$E < 100$ mSv	$<\frac{1}{10}AD_{T,Table\ 2}$

Responsibilities of the MP (1)

- Assess patient dose due to internal and/or external irradiation and provide advice on the clinical care of patients.
- Promote the safety of patients and workers and a safety culture as the cornerstone of limiting radiation exposure and the spread of contamination in a nuclear or radiological emergency.
- Promote the use of universal standard precautions as the minimum level of protection when providing care for patients.

Responsibilities of the MP (2)

- Assess what personal protective measures are indicated given the available resources.
- Implement appropriate contamination control measures.
- Monitor radiation exposure of the staff.
- Keep staff informed and provide frequent updates to team members. Help in the preparation of messages directed at communicating with patients, their families and the general public to the required extent, in coordination with the team responsible for communication

Responsibilities of the MP (3)

- Know the signs of worker stress.
- Remind workers that proper use of PPE prevents them from being contaminated.
- Remind workers that time, distance and shielding can reduce exposure to radiation.
- Inform pregnant workers about the risks associated with response efforts, and exclude them from the team supporting the response if the staff dose is expected to exceed the limits for pregnant workers.

Responsibilities of the MP (4)

- Remind workers not to eat or drink while participating in the response.
- Remind workers to monitor electronic personal dosimeters (EPDs) and to request assistance when removing PPE.

Main MP task summary



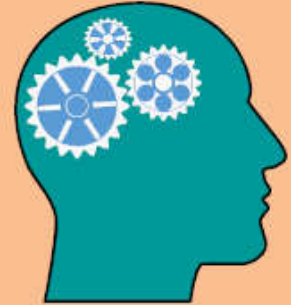
Supporting medical response and radiation protection activities at the hospital level.



Ensuring personal radiation protection of the health care team or other workers.



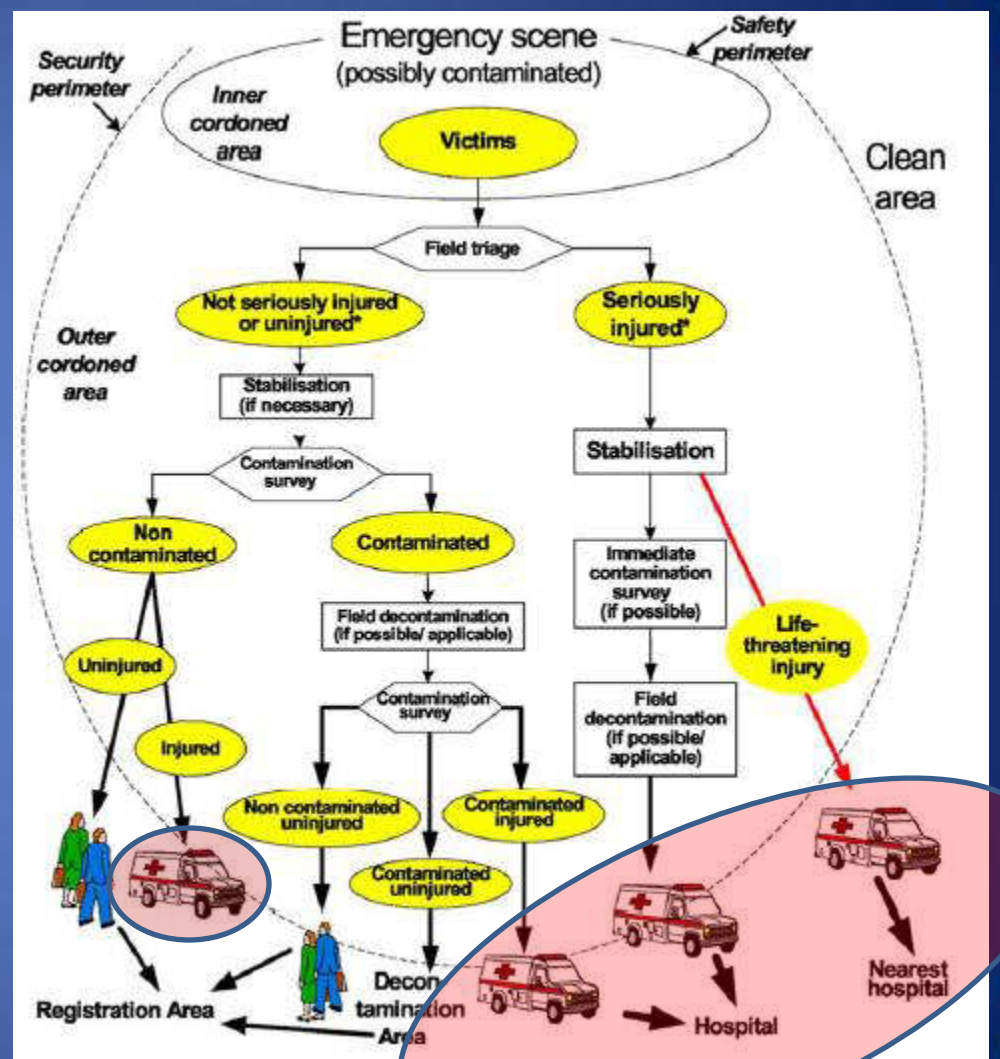
Implementing contamination control measures.



Providing input to the communication team for the preparation of messages for patients and the general public

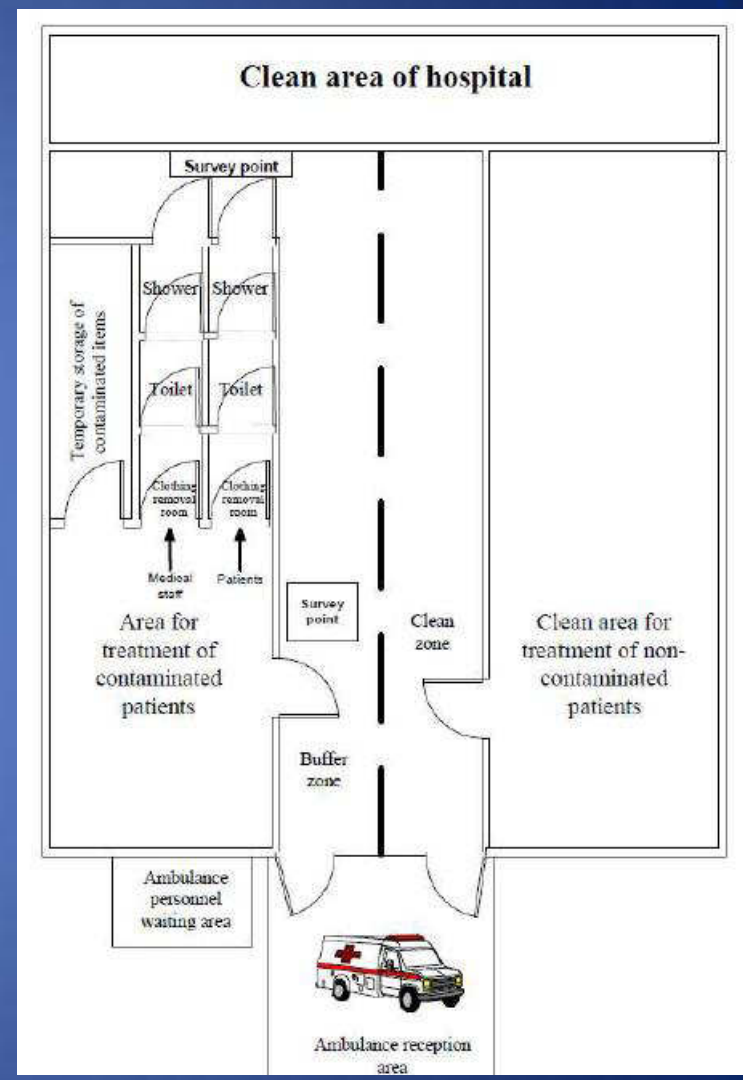
The big picture

- Lots of players and decision points
- Hospital inputs shown



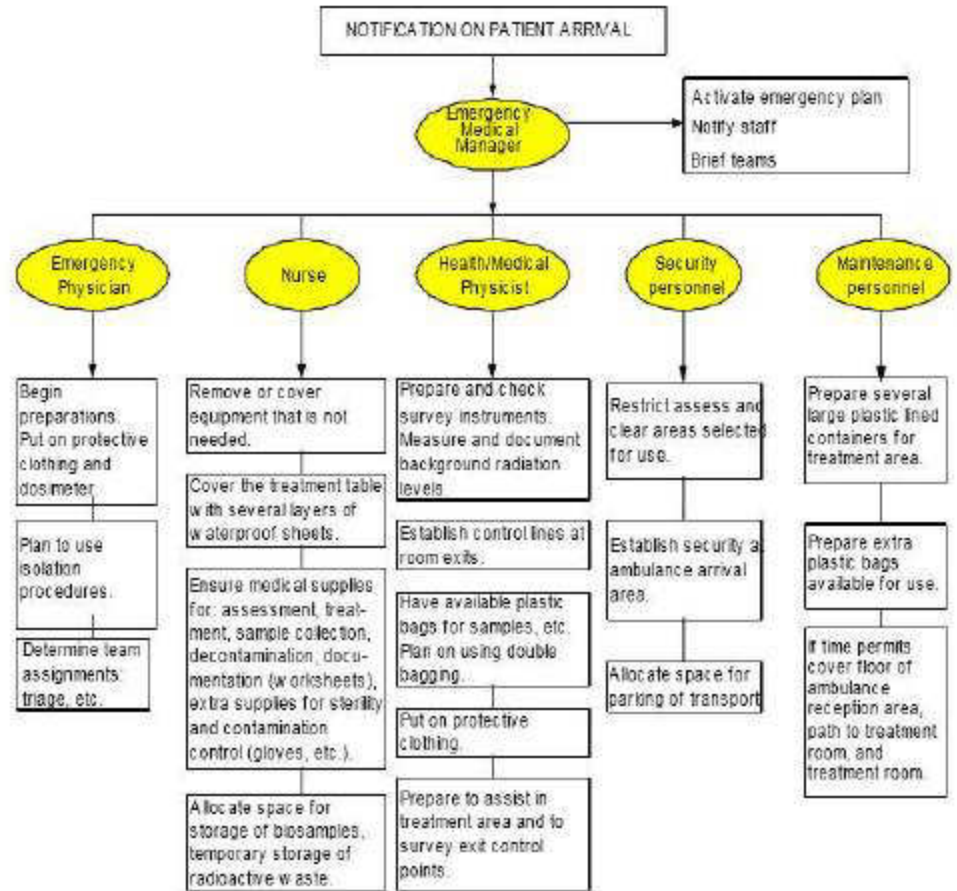
Hospital

- Know your flow
- Pre-decide
- CEO approved



Hospital

- Preparation for contamination control prior to patient arrivals



Equipment and supplies

- Rolls of plastic or paper to cover floors and unneeded equipment
- Tape for securing the floor covering and marking floors
- Caution tape and warning signs for marking controlled areas
- Large plastic bags for trash
- Plastic trash bags for contaminated clothing, tags and marking pens
- Small bags for contaminated personal items with tags or marking pens

E.g. Hospital Treatment Area

- Establish controlled area with temporary barriers, signs, security staff
- Cover floor of controlled areas and tape in place
- Large bins with plastic liners for waste
- Sufficient plastic bags for samples
- Remove or cover non-essential equipment from controlled area
- Establish control lines and monitor anyone or anything leaving the controlled area

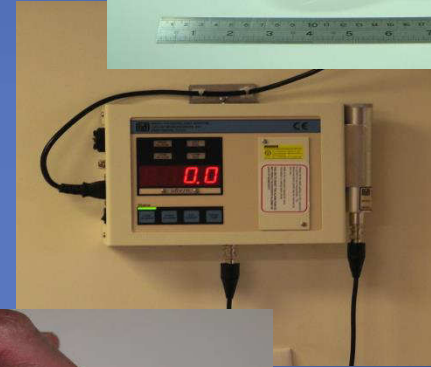


Monitoring equipment and PPE

- Protective suits/gowns
- Disposable gloves
- Surgical caps
- Shoe covers
- Tape
- Face shields
- Electronic dosimeters
- Individual TLD or OSL
- Survey meter
- Contamination meter
- Patient contamination charts

E.g. Hospital Equipment

- Two area radiation monitors - ambulatory and ambulance entrances to emergency department
- Two RADOS personal monitors
- Two CYPHER contamination monitors
- Two rolls of barricade tape
- Six radiation warning signs



Sample Needed	Reason
FBE and differential STAT, followed with absolute lymphocyte counts every 6 hours for 48 hours (TBI)	Assess radiation dose; initial counts establish a baseline; subsequent counts reflect degree of injury
Routine urinalysis	Determine if kidneys are functioning normally and baseline of urinary constituents
Swabs from body orifices	Assess possibility of internal contamination
Wound dressing and/or swabs from wounds	Determine if wounds are contaminated
Urine: 24 hour specimen × 4 days Faeces × 4 days	Body excreta may contain radionuclides if internal contamination has occurred

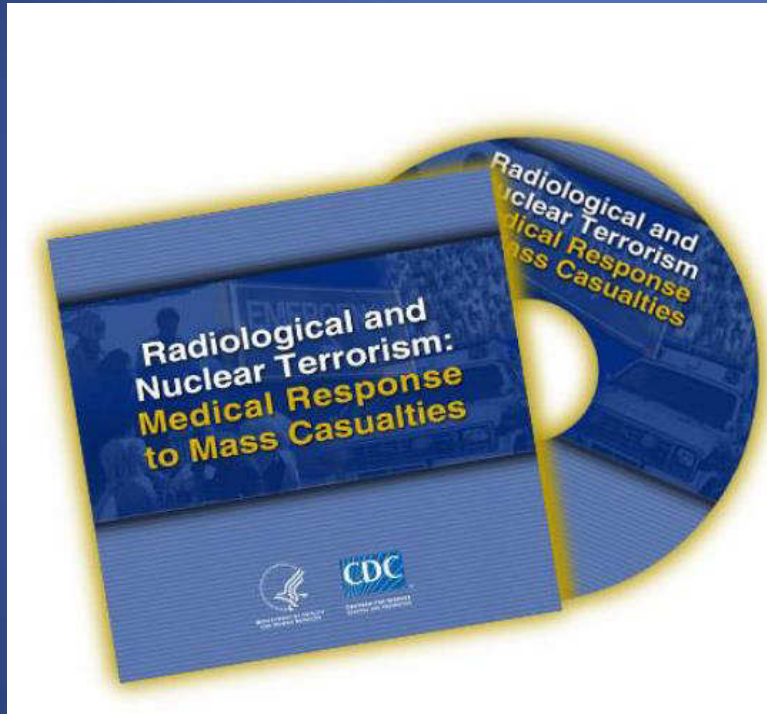
Procedures needed

- How to don and doff PPE
- How and where to wear EPD and TLD/OSL
- How to prepare hospital areas to receive patients
- How to decon and where to decon patients
- How to survey for contamination
- How to swab, bag and tag biological samples
- How to do all these things and keep smiling !

Conclusions

- You can make a real difference during a radiological emergency
- Preparedness starts with you, but you are not alone
- Find your ED Radiation Emergency Plan

Resources



EPR-Pocket Guide
for Medical Physicists
2020

EMERGENCY PREPAREDNESS
AND RESPONSE

**Pocket Guide for Medical
Physicists Supporting
Response to a Nuclear or
Radiological Emergency**

 **IAEA**
International Atomic Energy Agency

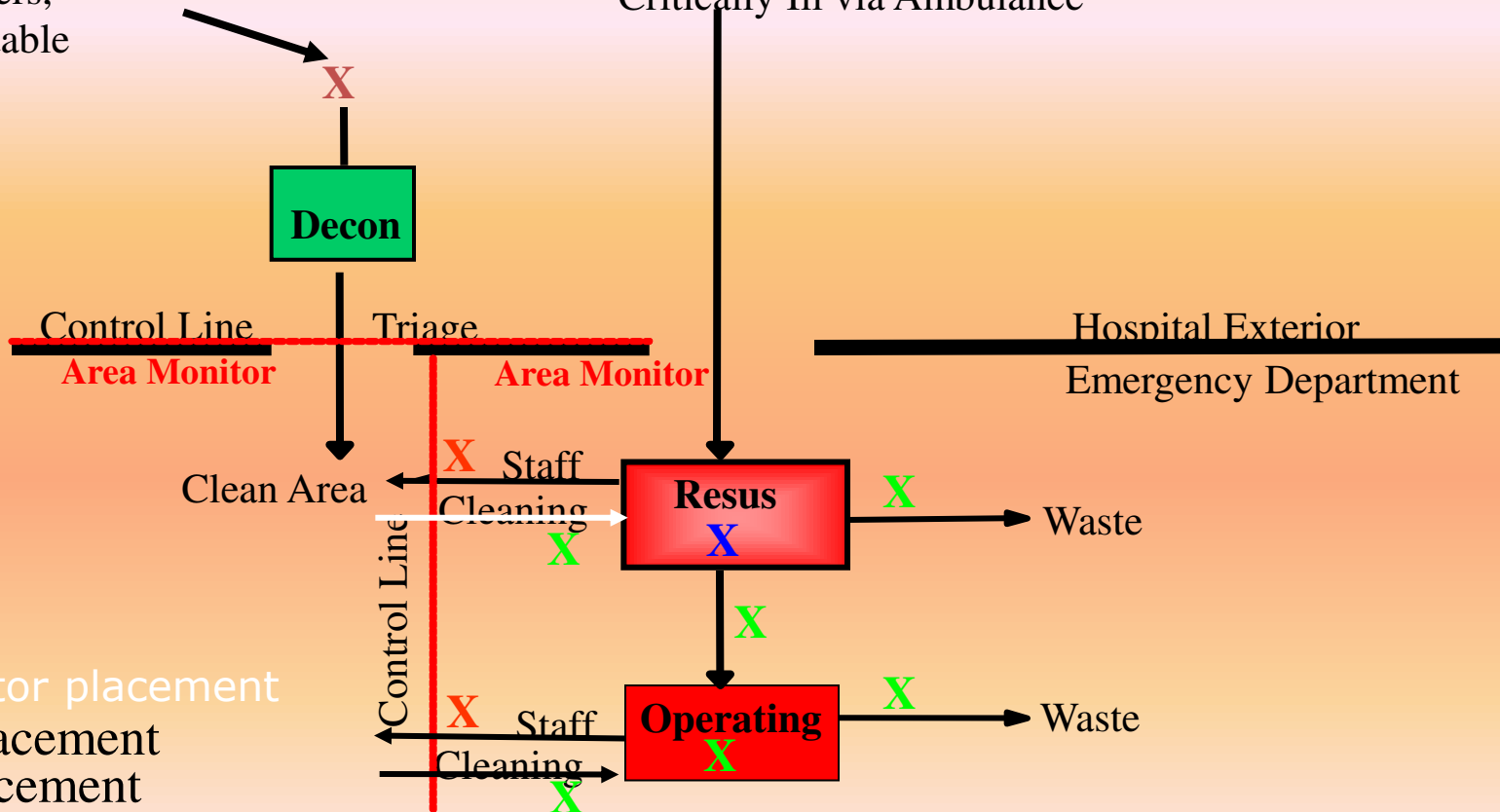
Questions ?



Hospital Radiation Contamination MCI Flow Diagram With 2 area monitors and 2 Cypher monitors

Self-presenters,
Medically stable

Critically Ill via Ambulance



Hospital Exterior
Emergency Department

Cypher monitor placement

- X Initial placement
- X Later placement
- X Final tasks