The Augmented Role of the Medical Physicist in Radiation Emergencies

A/Prof Brad Cassels
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 focuses 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

Deadly Toxin Scare for City

Box sparks road blocks

A-Plant Mishap Leaks Radiation

Contaminated steam escapes in Pa.

Win big $$$ in new Post game

International Atomic Energy Agency, Vienna
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Transport accident involving radioactive material</td>
<td>4. Fire incident involving a premise containing or a vehicle transporting radioactive material</td>
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<tr>
<td>2.</td>
<td>Loss and theft of radioactive material</td>
<td>5. Explosion of a dirty bomb</td>
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<td>3.</td>
<td>Finding of suspected radioactive material</td>
<td>6. Incident response to nuclear threats (direct and consequence management)</td>
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<td>Type of radiation emergency</td>
<td>Emergency preparedness category</td>
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<tr>
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<td>Cat IV</td>
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<tr>
<td>Reactor (OPAL)</td>
<td>Cat II</td>
<td>Possible</td>
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<td>Reactor (NPW)</td>
<td>Cat V, with conditions of Cat I or II</td>
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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

Emergency Management Manual Victoria

Australian Contingency Plan for Space Re-Entry Debris (AUSCONPLAN - SPRED)

Safety Plan for the Visit by Nuclear Powered Warships to Port Darwin
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 (AUSCONSPLANSPRED)
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

Is there a hospital-defined chain of command under an ICS?

YES
The role of the MP and chain of command will likely be in the hospital in the radiation emergency response plan.

NO
The MP should find out:
Who am I reporting to? The MP’s supervisor/manager for hospital activities may not be the person designated to manage the MP’s activities during a radiation emergency response.

Who am I responsible for? The role and responsibilities assigned to the MP should be clearly defined in the 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

<table>
<thead>
<tr>
<th>Dose Rate</th>
<th>Time to receive 1 mSv</th>
<th>Time to receive 20 mSv</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 μSv/hour</td>
<td>41 days</td>
<td>2 years 3 months</td>
</tr>
<tr>
<td>10 μSv/hour</td>
<td>4 days 4 hours</td>
<td>83 days</td>
</tr>
<tr>
<td>100 μSv/hour</td>
<td>10 hours</td>
<td>8 days 8 hours</td>
</tr>
<tr>
<td>1 mSv/hour</td>
<td>1 hour</td>
<td>20 hours</td>
</tr>
<tr>
<td>10 mSv/hour</td>
<td>6 minutes</td>
<td>2 hours</td>
</tr>
<tr>
<td>50 mSv/hour</td>
<td>1 minute</td>
<td>24 minutes</td>
</tr>
<tr>
<td>100 mSv/hour</td>
<td>-</td>
<td>12 minutes</td>
</tr>
</tbody>
</table>
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...

### Tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Guidance value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$H_p(10)$ **</td>
</tr>
<tr>
<td>Life-saving actions</td>
<td>&lt;500 mSv</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Actions to prevent severe deterministic effects and actions to prevent the development of catastrophic conditions that could significantly affect people and the environment</td>
<td>&lt;500 mSv</td>
</tr>
<tr>
<td>Actions to avert a large collective dose</td>
<td>&lt;100 mSv</td>
</tr>
</tbody>
</table>

Source: IAEA EPR-MEDPHYS 2020. Guidance values for protection from deterministic events can also be found there.
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 CYPHERER contamination monitors
- Two rolls of barricade tape
- Six radiation warning signs
<table>
<thead>
<tr>
<th>Sample Needed</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBE and differential STAT, followed with absolute lymphocyte counts every 6 hours for 48 hours (TBI)</td>
<td>Assess radiation dose; initial counts establish a baseline; subsequent counts reflect degree of injury</td>
</tr>
<tr>
<td>Routine urinalysis</td>
<td>Determine if kidneys are functioning normally and baseline of urinary constituents</td>
</tr>
<tr>
<td>Swabs from body orifices</td>
<td>Assess possibility of internal contamination</td>
</tr>
<tr>
<td>Wound dressing and/or swabs from wounds</td>
<td>Determine if wounds are contaminated</td>
</tr>
<tr>
<td>Urine: 24 hour specimen × 4 days Faeces × 4 days</td>
<td>Body excreta may contain radionuclides if internal contamination has occurred</td>
</tr>
</tbody>
</table>
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
Questions ?
Hospital Radiation Contamination MCI Flow Diagram With 2 area monitors and 2 Cypher monitors

Self-presenters, Medically stable

Critically Ill via Ambulance

Decon

Control Line ×

Triage

Area Monitor

Clean Area

Resus ×

Operating ×

Waste

Hospital Exterior

Emergency Department

Control Line

Area Monitor

Area Monitor

Staff Cleaning

Staff Cleaning

Staff

Initial placement

Later placement

Final tasks

Cypher monitor placement

Clean Area