GUIDELINE IN HANDLING RADIATION EMERGENCY IN HOSPITAL UMUM SARAWAK

[2017]

Tajuk Dokumen	GUIDELINE IN HANDLING RADIATION EMERGENCY IN HOSPITAL UMUM SARAWAK
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PART 1: INTRODUCTION

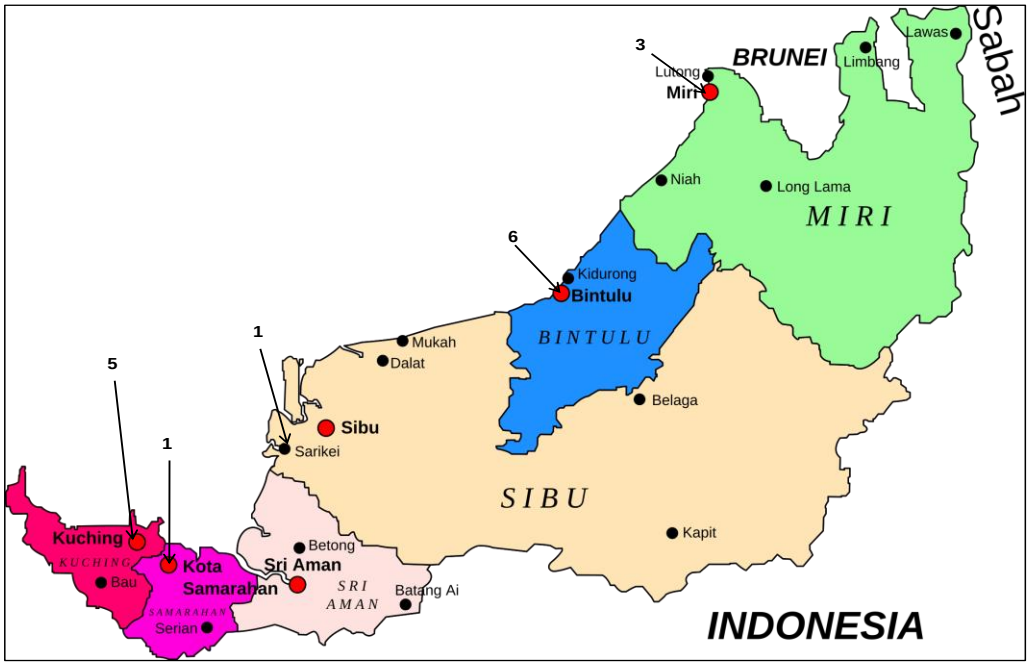
1.1 General Introduction

This guideline intends to be a guide to the preparedness and actions in handling radiation emergency situation or accidents at hospital or in the field within SARAWAK.

1.2 Objectives

(a) To provide a guideline for handling radiation emergency situation or accidents.
(b) To provide a background understanding of current risks and types of radiation effects on patients.
(c) To provide relevant links to resources to assist hospitals in making necessary preparation for radiation accidents.
(d) To provide general guideline in special situation with regard to radiation.

1.3 Radioactive Industrial Sources Mapping In Sarawak



(a) Industrial:

Area	Total Radioactive Source
Kuching	5
Samarahan	1
Sarikei	1
Bintulu	6
Miri	3

1.4 Types Of Radioactive Sources In Sarawak

(a) Industrial

Radioactive Sources	$T_{1/2}$	Emissions
Cobalt-60	5.27 yrs	β-,γ
Cesium 137	30 yrs	β-,γ
Iridium 192	74 days	β-
Uranium 238	4.5x10^9 yrs	α,γ
Americium 241	458 yrs	α
Cerium 137	9 days	β+
Californium 252	2.645 yrs	n
Nickel 63	101 yrs	β-
Barium 133	10.51 yrs	EC
Sludge and Scale*		

(b) Medical

Radiotheraphy & Oncology Department

No.	Source	Activity	Category	Remark
1.	Iridium 192	521.9 GBq	3	Solid/ Sealed source

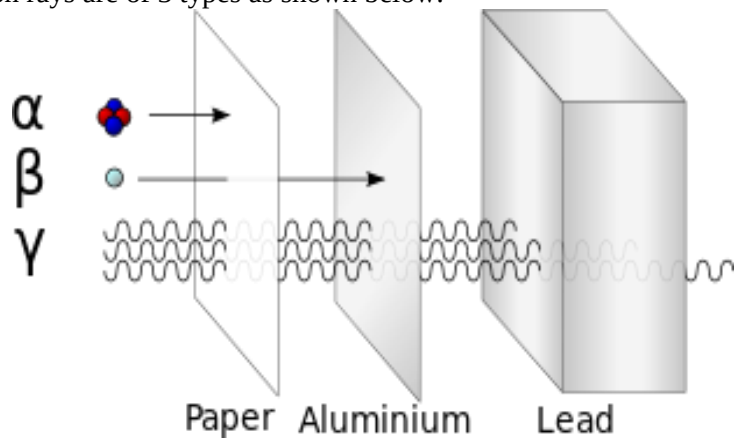
Nuclear Medicine Department

No.	Source	Activity	Category	Remark
1.	Cobalt 57	370MBq	2	Solid/Sealed Source
2.	Iodine 131	450mCi	3	Liquid/unsealed source
3.	Samarium 153	105mCi	2	Liquid/unsealed source
4.	Tc-99	1000mCi	1	Unsealed source
5.	Yttrium 90	60mCi	2	Unsealed source

PART 2: PRINCIPLES OF RADIATION SAFETY

2.1 Types Of Radiation Rays

Radiation rays are of 3 types as shown below:



a. **Alpha** – there are fast moving helium atoms. They have high energy, and stopped by just a few inches of air, or a piece of paper.

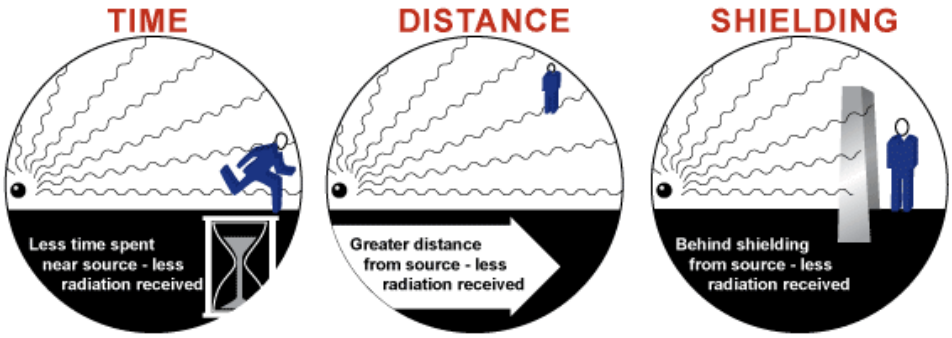
b. **Beta** – there are fast moving electrons. They are able to penetrate further, through several feet of air, or several millimeters of plastic or less of very light metals.

c. **Gamma** – these are photons with high penetration and they can penetrate several inches of lead depending on their energy.
Note: X-Rays and gamma rays are really the same thing – the difference is how they were produced. X-Ray machines are no longer emitting radiation once they are switched off.

2.2 Annual Dose Limits

Tissue or Organ	Radiation Worker (mSv/yr)	Member of Public (mSv/yr)
Whole of body	20	1
Lens of eye	20	15
Skin	500	50
Hands and feet	500	50
Pregnancy once declared	2 mSv to lower trunk (1 mSv to foetus)	Foetus is considered to be member of public

2.3 The Principle Of ALARA



The fundamental principle of radiation safety is that radiation exposures should be maintained As Low As Reasonably Achievable (ALARA). The three factors influencing radiation dose are:

a. Distance
   i. Determine safe distance via calculations performed by Medical/Health Physicists.
   ii. A safe area therefore could be established following the recommendation by Medical/Health physicist.

b. Time
   i. When a medical personnel has no choice but manage the patient in close range, the time allowed can be calculated by Medical/Health Physicists.

   ii. A '*personal dosimeter*' to determine the radiation dose of medical personnel can help determine the total dose received. If available, this can be used.

   iii. People can take up radiation but to a limited dose. We all are exposed to radiation from the background natural sources and the average dose from this is 300 Milirems (3mSv) a year. For workers (which includes medical personnel), the limit will be 2000 Milirems (20 mSv) a year (excluding the average dose of 300 Milirems (3 mSv) a year). For those under 18 year-old is 500 Milirems (5 mSv) a year (the dose is the same for fetus pregnant ladies but not more than 50 Milirems (0.5 mSv) per month).

c. Shield

   i. Medical personnel may use barrier-nursing principle to handle patients. The approach should be similar to the ones used to handle infectious diseases. Similar personal protective equipment (head cover), goggles or face-shielded mask, surgical mask, gown, apron, boots and shoe cover) may be used. If budget allows, quality available protective overalls may be purchased to be used. This is particularly of need for frontlines as the time taken to don them is much less.

   ii. Unlike X-rays, leads an apron does not protect a practitioner from Gamma rays and in some situations may even slow down work and result in higher dosage exposures.

PART 3: TYPES OF ACCIDENTAL EXPOSURE

3.1 Types of Accident

Potential accident types include the following:

(a) In factories, work places and research centers involving the usage of radiation and radioactive substances.
(b) In hospitals where there are facilities for radioisotopes and radiation services. These include primary isotopes used in Nuclear Medicine Department (99mTc, 131I, 67Ga, 51Cr, 137Cs, 32P, 90Y), isotopes used in Radiotherapy & Oncology Department (60Co,192Ir, 125I).Type of radiation emitted by the decay of the above radionuclide and their half life
(c) During the transportation of radioactive materials, accident can occur anywhere along the path of transportation.
(d) Radiation can take place in extraneous sources, i.e. mishaps which take place in other countries, but has an impact on Sarawak.

Basically, there are five types of injuries or combination of injuries associated with radiation and radioactive contamination as Table I below:

CATEGORY	DESCRIPTION AND TREATMENT
A	**Simple trauma with no irradiation and no radioactive contamination**. Does not constitute radiation hazard to both attendants and patients. Should be treated like any other patient with physical trauma.
B	**Patient expose to external radiation only. No radioactive contamination.** Exposure can be to a part of the body or whole body. Does not constitute a risk to attendants or public. Irradiation can occur following an exposure to a radioactive source or as an accidental exposure to X-rays in radiology and radiotherapy departments. Treatment is in the form of symptomatic and supportive measures. Exposure to more than 10 rem (100 mSv) requires observation and blood examination to identify the dose received. Exposure to high doses, ie more than 200 Rad (2 Gy) to the whole body produce Acute Radiation Syndrome (ARS). Symptomatic treatment is needed. These include symptomatic pain relief maintenance of electrolyte balance, prevention and treatment of infection, administration of growth factors and/or bone marrow transplant.

C	**Patients with internal contamination only (those patients who inhaled/swallowed radioactive material).** Urgent measures to prevent incorporation of radioactive substance are required. The inhaled dose is usually not high enough to produce risks to the patient's attendants. Its effect on the patient will depend on the types and activity of radioactive material. Need careful examination to access external contaminations. Need specific measures to minimize the effects of internal contamination.
D	**Patients with external contamination of the skin and clothing.** This constitutes a potential risk to both patients and the patient's attendants. Hence adequate protective measures need to be taken and the treatment should be in a specially designated area and away from other patients and public. Immediate protective measures such as removal of clothes and washing of the skin should be done after patient has been stabilized. Items removed need to be collected in radiation hazard labeled plastic bags and sent to radiation laboratory for analysis.
E	**Patients with contaminated wound and possible internal contamination.** Like category D there is slight risk to patient's attendants and public. Procedures similar to those in category D should be carried out. Care must be taken not to cross contaminate the cleaner part of the skin from the wounded areas or-vice versa. Any wound excision/debris should also be sent for analysis. Measures to minimize the internal contamination and incorporation of radioactive substances are required.

TABLE I: COMMON RADIATION SOURCES, FACILITIES AND EXPOSURE MODES

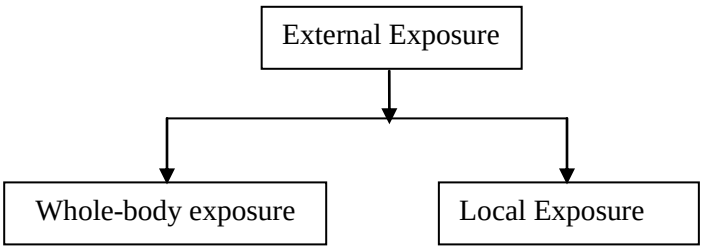
Group	Source and/or facility	External exposure	Contamination	Mixed
I	Critical assembly	Yes	Yes	Yes
	Reactor	Yes	Yes	Yes
	Fuel element manufacture	Yes	Yes	Yes
	Radiopharmaceutical manufacture	Yes	Yes	Yes
	Fuel reprocessing plant	Yes	Yes	Yes
II	Radiation device, e.g.			
	Particle accelerator	Yes	[a]	[a]
	X ray generator	Yes	No	No
III	Sealed source (intact)	Yes	No	No
	Sealed source (leaking)	Yes	Yes	Yes
IV	Nuclear medicine laboratory	Yes	Yes	Yes
	In vitro assay laboratory	Yes	Yes	Yes
V	Source transportation	Yes	Yes	Yes
VI	Radioactive wastes	Yes	Yes	Yes

[a] Neutrons may induce radioactivity within the body

3.2 External Vs Internal Radiation Exposure

3.2.1 **External** exposure occurs when all or part of the body is exposed to a penetrating radiation field from an external source. During exposure this radiation can be absorbed by the body or it can pass completely through, similar to a chest x-ray.

Note: That exposure to a radiation field does not cause an individual to become radioactive; the radiation exposure ceases as soon as the individual leaves the radiation field (refer to Table I). Physical measuring equipment such as Geiger–Müller detectors can be used.



3.2.2 Internal Exposure

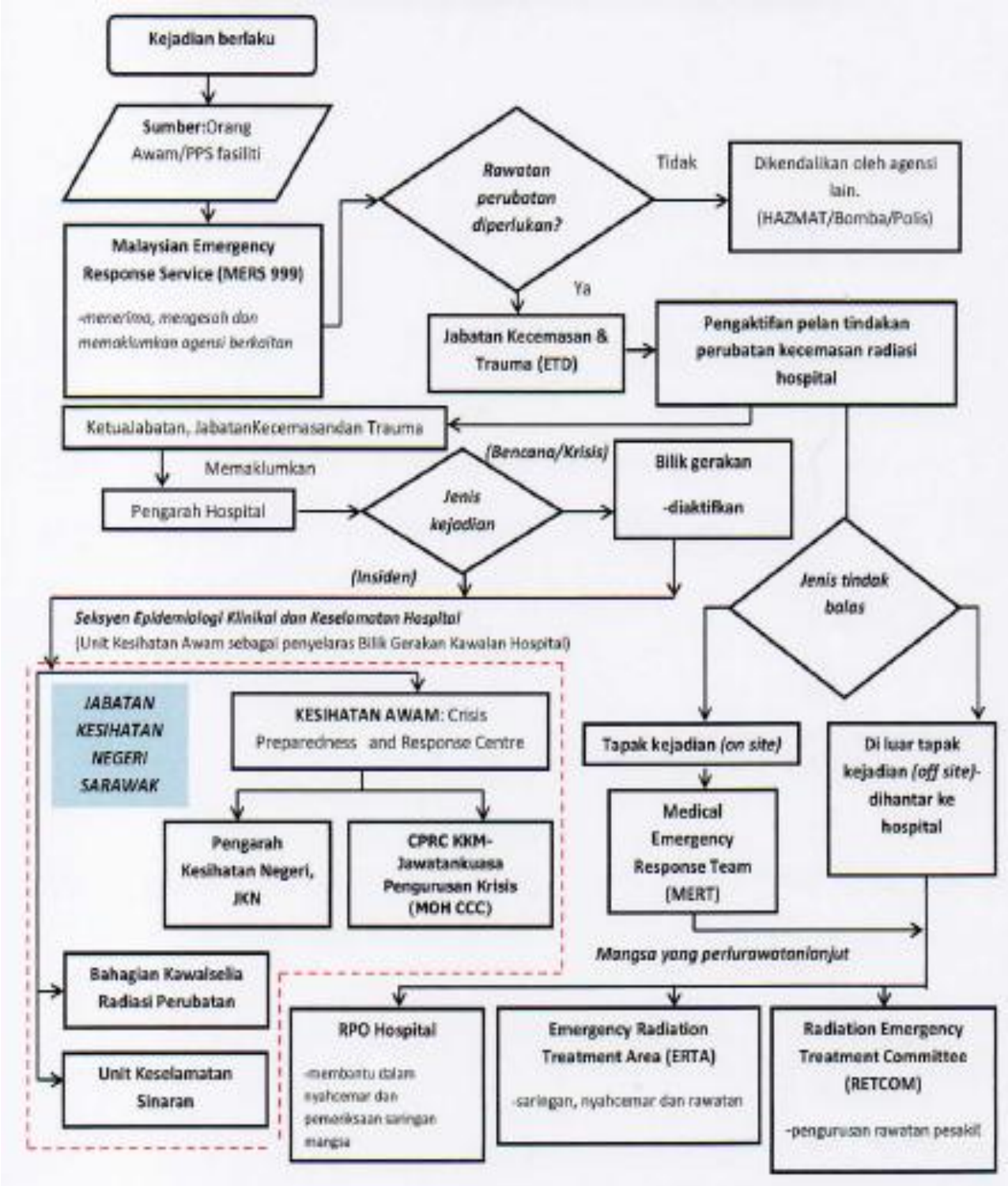
The other type of radiation injury involves **contamination** with radioactive material. Contamination means that radioactive material in the form of gases, liquids, or solids are released into the environment and contaminate people externally (such as on the skin), internally (such as by ingestion), or both (refer to Table I).

Internal contamination can result from inhalation, ingestion, direct absorption through the skin, or penetration of radioactive materials through open wounds. Physical measurement includes thyroid monitoring, whole body counting, gamma camera measurement, and blood and excreta analysis.

X-ray machines contain no radioactive material, and thus pose no threat of contamination even when energized. When energized, an x-ray machine is a source of external radiation exposure.

PART 4: ACTIVATION OF RADIATION EMERGENCY MEDICAL RESPONSE PLAN (EXTERNAL INCIDENT)

4.1 Flow of Notification of External Incident (*Chart from JKNS*)



4.2 Action Pathway for External Incident in HUS:

1. When an incident occurs, either the public or the premise RPO (or representative) will inform Malaysian Emergency Radiation Service (MERS 999).
2. The MECC will verify the incident if the information is coming from the public but no verification required if the information comes straight from the premise's RPO.
3. The MECC will then alert the active Emergency Physician on duty (EP) ETD if medical treatment is required and subsequently to active the Radiation Emergency Medical Plan.
4. Roles of the Emergency Physician ETD on duty During the Incident :
    a. Inform the Head of the ETD who will subsequently inform the hospital director.
    b. Instruct ETD SAMO to prepare and assemble the Medical Emergency Radiation Team (MERT).
    c. MERT will consist of Specialist (Emergency Physician) / Medical Officer, Assistant Medical Officer, Staff Nurse, Radiation Safety Officer (RPS), PPK and Driver.
    d. The RPS following the team will be instructed by HUS's RPO
    e. Facilitate and supervise preparation for management of patients.
5. Roles of the RPO During the Incident:
    a. The RPO heads all RPS and can give any instructions to any of the RPS
    b. RPS can be instructed to necessary areas (eg. Follow the MERT be stationed at the triage area, Emergency Radiation Treatment Area (ERTA)/decontamination room.
    c. RPO provides radiation safety advice to be followed by all.

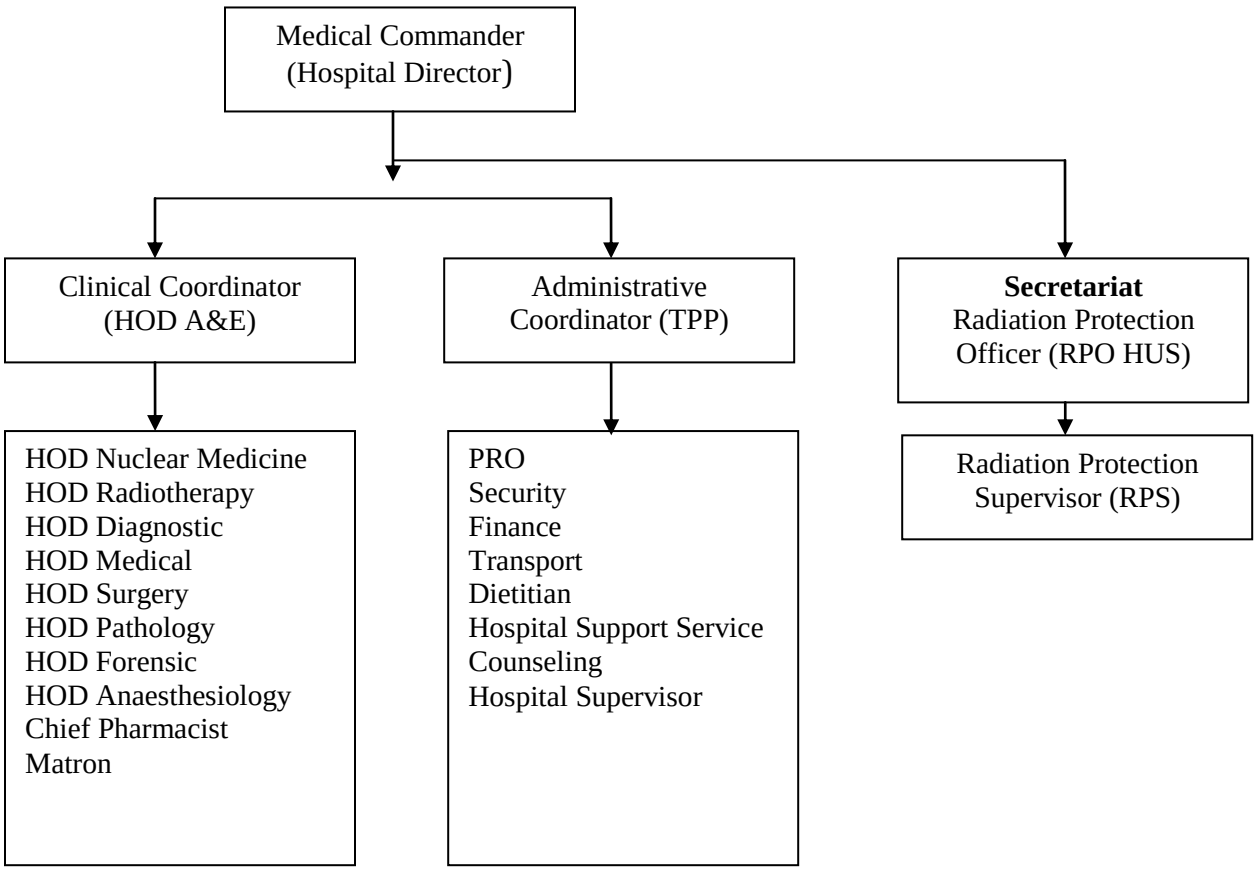
4.3 Operations Room (*Bilik Gerakan*)

Operations room will be opened and coordinated by *Unit Kesihatan Awam* (*UKA) HUS.*

4.4 Radiation Emergency Treatment Committee (**RETCOM**)

RETCOM will oversee, complement and advise on actions taken for the management of patient. RETCOM will prepare report regarding current and after event. During the Radiation phase, the RETCOM will form an organization in line with the Incident Command System.

ORGANIZATION CHART RETCOM



4.4.1 Role and Responsibilities of Personnel involved;

Personnel	Function
Medical Commander (Hospital Director)	Oversee the overall hospital Radiation operation.
Clinical Coordinator (HOD Emergency & Trauma Department)	Coordinate clinical activities.
Administrative Coordinator (Deputy Director of Hospital)	Coordinates hospital Radiation and assures normal hospital operations (TPP).
Head of Departments (HOD)	Support clinical needs and expertise
Radiation Protection Officer (RPO)	Leads in technical advices and assists coordination.
Emergency Doctors/ physicians	Diagnose, treat and provide emergency medical care; can also function as team coordinator or triage officer.
Radiation Protection Supervisor (RPS)	Surveys and measures the contamination and performs triage.
Nurse	Assists physician with medical procedures, collection of specimens, radiological monitoring, and decontamination, assesses

	patient needs and intervenes appropriately.
Public Relation Officer (PRO)	Manages media needs and releases information to public and media based on Hospital Director's instructions.
Chief Pharmacist	Provides pharmaceutical support
Dietitian	Provides food with disposable utensils for patient and emergency team.
Counselors (Medical Social Workers and Clinical Psychologists)	Provides psychological and emotional support
Hospital support service	Provides maintenance support
Finance Officer	Provide emergency financial support.
Security personnel	Ensures security at the radiation emergency area and controls crowds.
Forensic	Proper handling of deceased body.

4.5 Medical Emergency Radiation Team (**MERT**)

MERT is the team sent from the hospital to the incident site to provide medical assistance. This team will be responsible for rendering emergency medical care to radiation emergency victims, both on site as well as in hospital.

The team consists of:

1. Specialist (Emergency Physician) or Medical Officer (leader)
2. Assistant Medical Officer
3. Staff Nurse
4. Radiation Safety Officer
5. *Pembantu Perawatan Kesihatan*- PPK
6. Driver

Each member of this team should be assigned with a specific function or combination of functions. The Medical Emergency Co-ordination Centre (MECC) at HUS may dispatch the usual nearest ambulance to the site upon receipt of emergency call.

4.5.1 Roles of the Emergency Physician on duty During the Incident:

1. Inform the Head of the Emergency and Trauma Department (if information via MECC) who will subsequently the hospital director.
2. Instruct the Emergency Department's Supervisor to open Operations Room in emergency department if required. Operation room will be opened depending on the needs of more staffs or specialized staffs in Radiation field to be called if the incident involves Mass Casualty Incident in line with HUS Emergency Radiation Plan.
3. Instruct ETD AMO to prepare and assemble the Medical Emergency Radiation Team (**MERT**).
4. MERT will consist of an ETD doctor, AMO, Staff nurse and health attendant (*Pembantu Perawatan Kesihatan*-PPK) (*if necessary*), Radiation Safety Officer (RSO) and a driver.
5. MERT will roll out and put on PPE. The team will be sent to the site for Radiation upon instruction by EP on call or HOD.
6. Facilitate and supervise preparation for management of patients.

This First Medical Emergency Radiation Team (**MERT**) is equipped with radiation detection equipment:

- All team members must wear standard PPEs (cap, goggles, mask, gown, apron and shoes cover)
- Ambulance team arriving at the incident site should immediately report to the individual in charge of the facility's radiation protection.
- If the incident is large enough, a command post may be set up. In this situation, the responding team should report to the On-Scene Commander at the command post.

The Medical Emergency Radiation Team (**MERT**) can first be dispatched to the site of the accident to make initial assessment and to determine whether injured victims are present. This team will report to the emergency committee and also deliver first aid care to the victims. This team need not comprise of all members of MERT, perhaps it is sufficient to send a few (two or three) personnel preferably comprising of a doctor, radiation protection officer (RPO) or health physicist, nurses or medical assistants to the site.

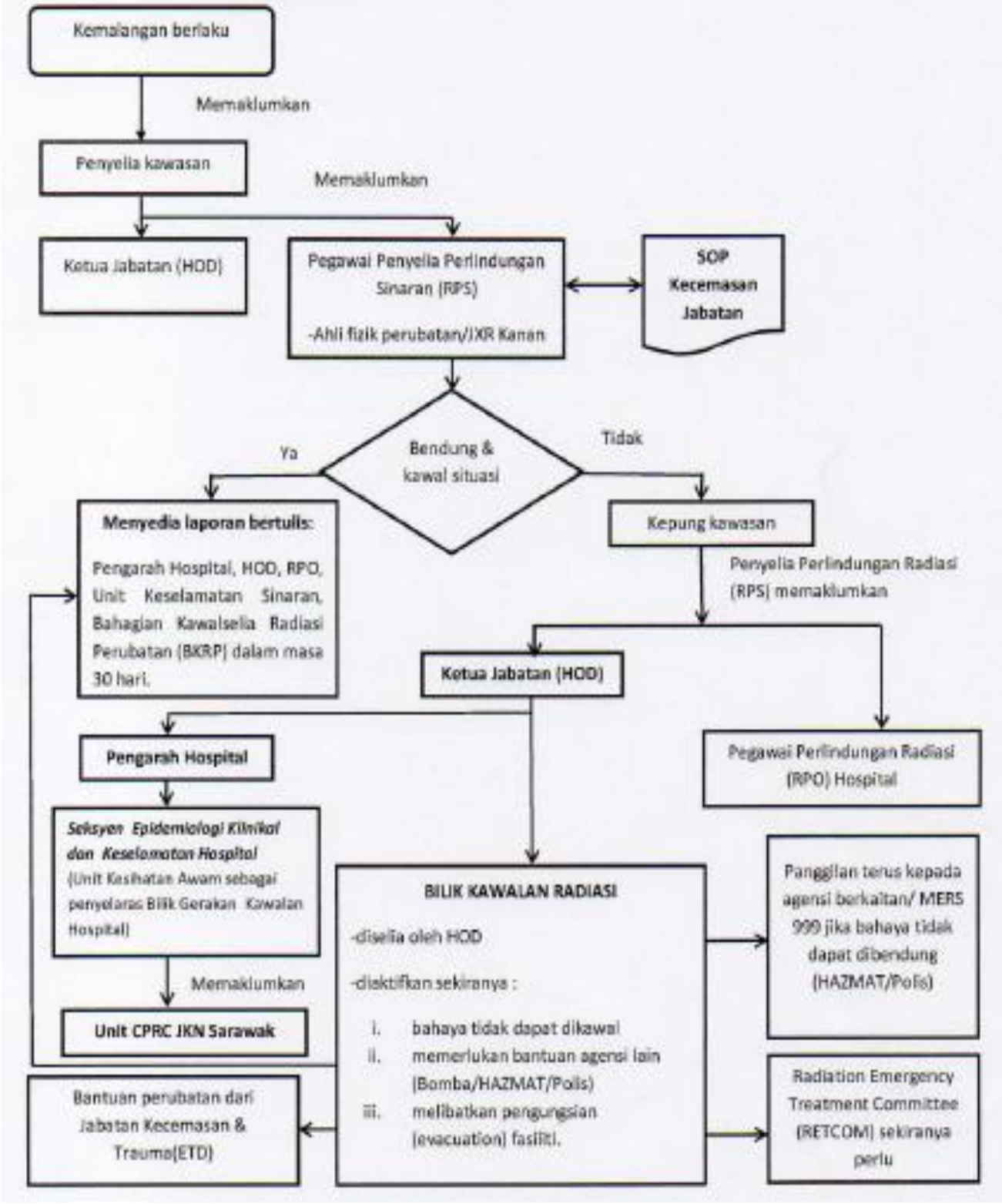
4.6 Emergency Radiation Treatment Area (**ERTA**)

The Emergency Radiation Treatment Area (at decontamination room). During examination the following will be taken:

1. Vital signs
2. History and clinical examination
3. Blood examination (Full blood count with differentials, Renal Profile, Liver Function Test, and Thyroid Function Test,

PART 5: ACTIVATION OF RADIATION EMERGENCY MEDICAL RESPONSE PLAN (INTERNAL INCIDENT)

5.1 Flow of Notification of Internal Incident (*Chart from JKNS*)



If the incident occurs within HUS, the incident and related information should be informed to the department's organization head and managers and subsequently to the call centre of the emergency department. The hospital director should be informed of the incident as well.

5.2 Action Pathway for Internal Incident in HUS;

1. When an internal incident occurs within HUS compound, the personnel should alert the area supervisor which could be a senior assistant medical officer (SAMO) or sister in-charge. He/she will then alert the radiation protection supervisor (RPS) of the department and specialist in- charge.
2. The specialist in-charge will then alert the head of department (HOD).
3. The RPS will assess the situation whether it can be contained or not. If the situation is containable, the RPS will control and contain the situation. After the situation is controlled, he will then write a report of the incident and submit it to the head of department and radiation protection officer (RPO).
4. If the situation cannot be contained, the RPS will cordon the area and alert the RPO. RPS will also inform the HOD regarding the current situation. HOD will then instruct RPS to set up a radiation control room. HOD will then inform the hospital director and OSH unit who will subsequently inform the CPRC unit, JKNS.
5. The affected area supervisor will call the relevant personnel to assemble at the radiation control room. They are the HOD as emergency manager (EM), RPO as incident controller (IC), area matron as evacuation controller (EC), Supervisor (Ketua Penyelia) as assistant incident controller (AIC), security manager as security controller (SC) and specialist or doctor in charge as medical controller (MC).
6. These controllers will make further decision regarding evacuation, to alert emergency department call centre for medical team, call for external assistance from HAZMAT/ Fire and rescue/ police, to alert RETCOM. These decisions are made depending on the advice of the RPO.

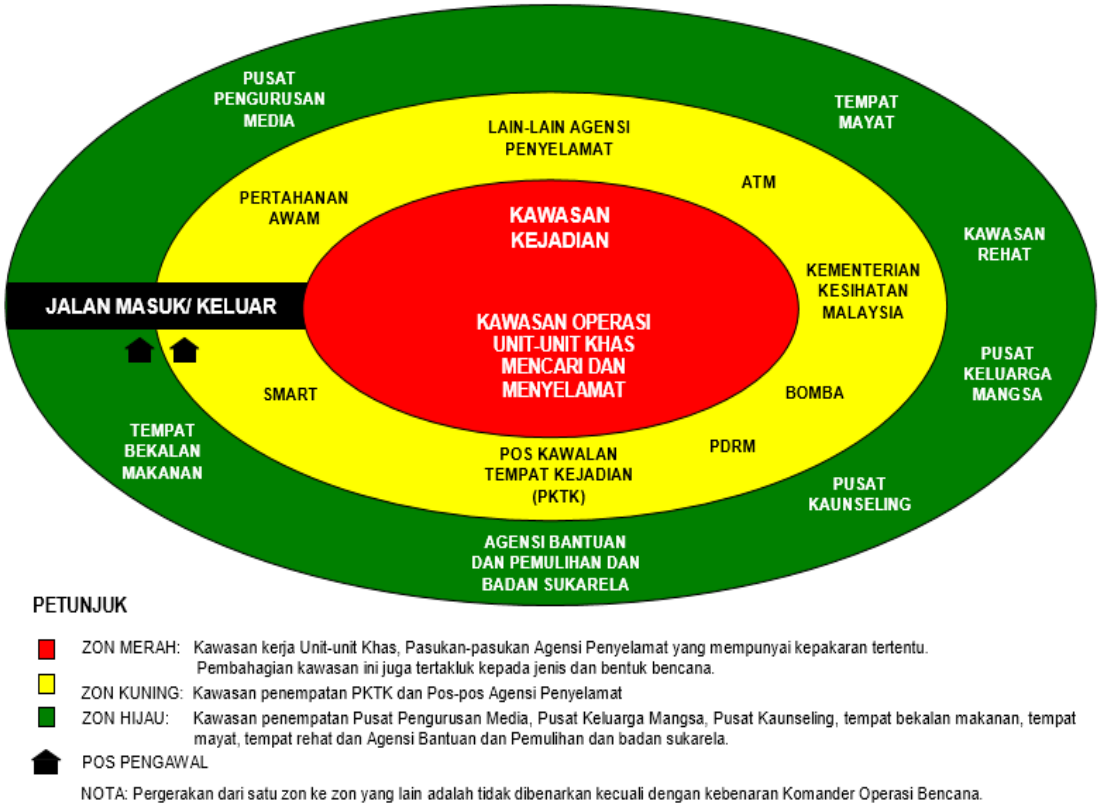
5.3 Role and Function of Operation Personnel

No	Personnel Involved	Function
1	HOD of Department Involved	Oversees overall activities to handle radiation emergency or any related incident (eg. fire, explosion, etc.)
2	RPO	• To control the incident. • Ensures control area established for contaminated and non contaminated zones. • Advises EM for measures to be taken in order to control situation. • Undertakes appropriate measures to handle situations (eg ensuring PPE worn by personnel, putting out fire, controlling entry and exit etc). • Assisted by RPS and Ketua Penyelia of affected unit.
3	Security	• Ensures security of area; • Control the crowd (personnel, patient and public). • Control the safety of area. • Control traffic
4	Area Matron	• Oversees evacuation process if required. • Assisted by sister in charge of the affected unit.

5	Specialist or Medical Officer in charge of the affected unit	• Ensure the medical well being of affected patient or injured personnel. • Provide medical treatment while waiting for medical assistance to arrive.
6	Unit Supervisor	• Responsible to give direction to staff and patients in the event of evacuation • Will be in-charge at the unit affected to oversee a smooth and controlled process of evacuation.

PART 6: ON-SITE PATIENT MANAGEMENT

Mass casualty incidents are managed according to Directive 20 of National Security Council. This directive states that during a mass casualty incident, the police will play the role of the On-Scene Commander, the Fire and Rescue will be the Forward Field Commander whilst Medical team from Ministry of Health will be the Medical Commander.



6.1 Mass Casualty Incident Management Involving Radiation

1. In Radiation Incident Involving Mass Casualty, patients will be **decontaminated first by the HAZMAT team** from Fire and Rescue before being delivered to the casualty collecting area (cold zone).
2. Patients are screened for radiation after decontamination before being passed to medical attention.

6.2 Actions To Be Taken by the MERT at the Incident Site

1. Obtain information and order from **On-site Commander**. The MERT team will remain in the "Yellow Zone".
2. All person suspected / exposed will be sent to the ETD Hospital Umum Sarawak. On-Site Commander will identify these individuals.

6.3 Preparation at Hospital

Exposure Only

ETD

1. Set-up Emergency Radiation Area.
2. Patient under the **category A or B (Exposure only with no radioactive contamination) (**refer to Table I**)** can be managed in ETD.
3. Non contaminated patients can be managed in same manner like any patients.

Exposure and Contaminated / Contaminated Only

This is required when report indicates that contaminated victims are present. The hospital should activate the Radiation Emergency Plan and should prepare for arrival of victim(s).

Emergency Decontamination Room

1. Set-up at Radioactive Ward, Nuclear Medicine Department.
2. Number of victim less than 3 patients.
3. Contaminated patients must be managed with protection (either via distance, time or shield) and medical physicist will advise this.

Emergency Decontamination Area

1. Number of victims more than 3 patients.
2. Set-up at Convention Hall, HUS.
3. Contaminated patients must be managed with protection (either via distance, time or shield) and medical physicist will advise this.

Decontamination Team

No	Position	Responsibilities
1	Doctor	• Takes charge of medical needs of patient • Directs decontamination procedure.
2	In-charge Nurse (Triage)	• Designates persons who will remain outside ERTA and obtain supplies for medical and decontamination teams. • Assists doctor • Responsible for collection of all specimens and swabs of contaminated areas. • Monitors and records vital signs.
3	Medical Assistant	• Assists doctor for decontamination or clinical procedures
4	Medical Attendant	• Assists medical team and helps with decontamination and moving contaminated clothes etc into appropriate storage
5	Radiation Protection Officer (RPO) or Radiation Protection	• Designates person who will remain at ERTA entrance to monitor all personnel, equipment and samples leaving ERTA. • Monitors patient, decontamination team and other involved persons for radioactivity during treatment and care of patient.

	Supervisor (RPS)	
6	Circulating nurse (from resuscitation)	• Assists as needed. • Labels all specimens • Picks up and passes on needed supplies that are delivered to the ERTA from the outside. • Records data on areas and levels of contamination as measured by RPO/RPS.

Hospital RPO will supervise the ED sister in-charge in the management of the decontamination room in ensuring the establishment of the following:

1. Triage counter
2. Plastic sheet to cover flooring
3. Covered trolley
4. Lead box ready to use
5. Emergency doctor from Green Zone of the Emergency Department to standby to examine patients with full PPE.
6. Relevant department to standby

Examination and stabilization will be done accordingly depending on injuries (if present) sustained. During examination the following will be taken:

1. Vital signs
2. History and clinical examination
3. Blood examination (Full blood count with differentials, Renal Profile, Liver Function Test, Thyroid Function Test)

6.4 Emergency Department and Decontamination Facility

a. For contaminated patients, general decontamination principle applies: this requires removal of clothes which will remove 90% of contaminants. The other 10% contaminant will be removed by water and soap.
b. Decontamination facilities in hospital could be upgraded to include decontamination trolley, water collection system and storage, cabinet to house PPEs, plastic sheets, brush, lead box for contaminant collection etc. The decontamination room has to be prepared (floor covered with plastic sheet and absorbable paper) in case some radioactive materials drop on the floor.
c. Whole body shower will produce larger amount of water to be collected for process. Whole body shower is done in cases of whole-body or large body area involvement of contamination.
d. Medical/Health physicist should be called to help screen the patient before and after decontamination.

6.5 Contaminated Patients In Need of Resuscitation

a. Should situation arise that patient needs resuscitation and medical personnel face the situation of not having time to put on a PPE, the IAEA recommends that immediate medical attention be given even without wearing PPE. The time taken to provide medical care will be limited and usually the dose affecting the medical personnel will not go beyond hazardous limits. Once stabilized, provider can proceed to don the PPE and the Medical/Health Physicist could calculate the dose rate and radiation allowed for each personnel.

b. A person can safely take up to 20 mSv/year of radiation. The amount affecting a responder without protection in this situation would be so much lower than the limit.

6.6 Decontamination room or Radiation Emergency Area (REA);

a. Cover floor with plastic, paper or bed sheets and secure to floor with tape.
b. Place strip of tape on floor of entrance to REA so as to delineate contaminated site from non-contaminated side.
c. Remove all non-essential equipment from room or cover with plastic film.
d. Cover all light switches and handles on cabinets and doors with tape.
e. Provide a suitable decontamination tray for the patient, using an autopsy table, stretcher or improvisation as described under medical equipment and other supplies.
f. Provide several large plastic or metal containers with plastic bags to receive discarded contaminated items, such as clothing, gauze and disposable supplies.
g. Insert batteries in radiation survey instruments and check operation.
h. Survey and record background radiation level in REA.

6.7 Decontamination team preparations;

a. Member dons full surgical dress
b. Use rest rooms in anticipation of prolonged attendance in REA.
c. Each member labels film badge with name and attaches it to street clothing.
d. Each surgical trousers and pull-over shirt
e. Surgical hood
f. Waterproof shoe covers
g. Surgical gown
h. Surgical gloves-tape gloves to sleeve and outfit to shoe covers
i. Second pair of surgical gloves – do not tape and change whenever torn and contaminated
j. Surgical mask.
k. Each member attaches personal dosimeter to outer gown at neck so it will not become contaminated easily; dosimeter is to be read periodically (every 15 minutes) during decontamination and data reported to RPO.

6.8 Equipment Preparation;

a. Items required by EMRT:
   - Protective clothing which include gowns, gloves, booths, coats/jackets, mask and shoe cover
   - Self-contained breathing apparatus
   - Radiological survey instruments eg. Multipurpose Geiger counter, film badge, pen dosimeter
   - First aid kits which include bandage, common first aid medications, blankets, sheets
   - Replacement fluid for iv therapy
   - Trolleys or stretchers
   - Facilities for CPR
b. Equipment required by RPO:
   - Beta gamma detector
   - Alpha detector
   - Batteries
   - Radioactive tape labels to mask containers holding contaminated specimen or swab

- Post-contamination tape labels

6.9 Admission and Isolation Wards

Any patient who is suspected of being exposed to any form of radiation should be managed by doctors who have been trained to do so or with the advise of such doctors. In most cases, patients who are stable should as far as possible, be transferred to a hospital which has adequate facilities and the expertise to manage such patients.

a. Similar isolation wards used for infectious diseases could be used to isolate contaminated patients.
b. Patient may be admitted under medical discipline but relevant disciplines like Oncology, Nuclear Medicine, Surgery and others may joint-manage the case depending on the nature of injury.
c. Nursing barrier applies and patients are treated not unlike other infectious diseases.
d. Medical/Health physicist could be asked to measure the radiation and recommend safe distance, time limits of exposure and appropriate shielding if applicable.
e. In ward, supportive management is provided – vital signs, urine output monitoring, baseline Full blood count with differentials, Renal Profile, Liver Function Test, Serum Amylase, Thyroid Function Test and Coagulation Profile may be sent. The full blood count may need to be repeated at intervals of between 4 to 8 hours and will depend on both the suspected exposure dose and the severity of clinical features at the time of presentation.
f. In ward blood count is monitored for evidence of haemopoeitic depression (fall in lymphocytes count and pancytopenia in severe cases). In severe haemopoitic depression, haemopoetic support using growth factor such as GM-CSF (Granulocyte Monocyte Colony Stimulating Factor) and the G-CSF (Granulocyte Colony Stimulating Factor) can be considered. Consider platelet transfusion if the level of platelets falls below 30,000/microlitre.
g. Treatment is largely supportive – anti emetic for nausea and vomiting, anxiolytic for anxiety, fluid and electrolyte replacement where necessary, broad spectrum antibiotics, , antiviral agent or antifungal where necessary.
h. Wherever appropriate, referral could be made to the Psychiatry team for counselling considering patient may suffer from anxiety and depression.

6.10 Patients Needing Surgery

No special preparations for ‘exposed only’ patients.

a. For contaminated patient, the operation theatre is prepared in the same manner that the decontamination room is prepared in the Emergency Department – plastic sheet cover on the floor.
b. All personnel wear PPE (surgical gown, mask, goggle, boot, boot cover, double gloves, apron and head cover)
c. A personal dosimeter may be used if available.
d. A Medical/Health physicist will be by the side to measure the level and the time limit allowed for surgeon, Anesthesiology and theatre staff.
e. If necessary, the staff will be changed and rotated according to the time advice provided by the physicist.

6.11 Management of Deaths

a. Post-mortem is only conducted in cases which are warranted.
b. Depending on the survey findings of a Medical/Health physicist (or AELB), decisions can be made whether post-mortem can be conducted safely.
c. If the cause of death is obvious, due to acute radiation injuries, post-mortem may not be necessarily conducted.

d. Contaminated bodies may be cremated and the remains kept in a lead case. For Muslims, the needs of '*mandi mayat'*, '*kapan*', '*solat jenazah'* and burial processes could only be allowed to be performed based on the advice given by Medical/Health physicist in terms of time limit allowed. PPEs could be supplied to the performer along with personal dosimeter if safety could be assured.
e. If for any reason either clinically or legally that a post-mortem is warranted, the time limit will be calculated and the personnel may perform the post-mortem if it is safe enough following the advice given by Medical/Health physicist. The post-mortem room can be prepared the same way as a decontamination room is prepared. Standard PPE is used for this purpose apart from a personal dosimeter, if available.

REFERENCES

1. Akta Perlesenan Tenaga Atom 1984 (AKTA 304)
2. Pelan Tindakan Bencana Hospital Kuala Lumpur Edisi 2008
3. HKL Radiation Plan Draft 1 May 2011
4. Pelan Tindakan Perubatan Untuk Kecemasan Radiasi, Jabatan Kesihatan Negeri Pulau Pinang 2016.
5. Radiation Emergency Medical Management: https://www.remm.nlm.gov/
6. Radiation Emergency Medical Mangement (REMM) App: Google/iOS
7. CDC Radiation Emergency Resource Library + Toolkit: https://emergency.cdc.gov/radiation/
8. Radiation Emergency Assistance Centre/Training Site (REAC/TS): https://orise.orau.gov/reacts/resources/
9. The Medical Aspects of Radiation Incidents REAC/TS Radiation Quick Reference Guide
10. IAEA - Manual for First Responders to a Radiological Emergency
11. IAEA - Generic procedures for medical Radiation during a nuclear or radiological emergency

ATTACHMENT 1: THE LIST OF TELEPHONE AGENCIES INVOLVED

NO.	AGENCY	NO.TEL
1.	POLIS/BOMBA/PERUBATAN	999
2.	HOSPITAL UMUM SARAWAK JALAN HOSPITAL, 93586, KUCHING, SARAWAK	082-276666
3.	HOSPITAL SARIKEI JALAN RENTAP, 96100 SARIKEI, SARAWAK	084-653333
4.	HOSPITAL BINTULU JLAN NYABAU, 97000 BINTULU, SARAWAK	086-859000
5.	HOSPITAL MIRI JALAN CAHAYA, 98000 MIRI, SARAWAK	085-420033
6.	JABATAN KESIHATAN NEGERI SARAWAK JALAN DIPLOMATIK, OFF JALAN BAKO, 93050, KUCHING, SARAWAK	082-473200
7.	UNIT SIAPSIAGAAN DAN TINDAK CEPAT KRISIS JABATAN KESIHATAN NEGERI SARAWAK	082-441780
8.	UNIT KESELAMATAN SINARAN SEKSYEN KEJURUTERAAN JABATAN KESIHATAN NEGERI SARAWAK	082-473200 SAMB. 291/330/449
9.	BAHAGIAN KAWAL SELIA RADIASI PERUBATAN KEMENTERIAN KESIHATAN MALAYSIA ARAS 3-4, BLOK E3, PARCEL E, PRESINT 1 PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN 62590 PUTRAJAYA	03-88924727/4728/4730
10.	LEMBAGA PERLESENAN TENAGA ATOM CAWANGAN SABAH & SARAWAK KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI SUBLO 13, LOTS 2370 &2371, BLOCK 32, KAWASAN PERINDUSTRIAN SIBIYU 97000 BINTULU, SARAWAK	086-330469, 086-315469, 086-339469 (Talian terus ke Ketua Cawangan) Ngu Theing Kui 014-3909327
11.	LEMBAGA PERLESENAN TENAGA ATOM BATU 24, JALAN DENGKIL, 43800 DENGKIL, SELANGOR, MALAYSIA	Talian Hotline Kecemasan: 1800 88 7999 03-89225848

ATTACHMENT 2: LIST OF RADIATION PROTECTION EQUIPMENT AVAILABALE IN SARAWAK GENERAL HOSPITAL

NO.	ITEM
1.	Disposable Coat Apron & Disposable Gloves
2.	Face Mask
3.	Shoe cover
4.	Absorbent Paper
5.	Plastic bags and plastic container
6.	Tissue wipe / Paper towel
7.	Caution Tape
8.	Radioactive Material Warning Sign
9.	Mobile Radiation Shield
10.	Model 14C Survey Meter with Pancake GM Probe
11.	Inspector Survey Meter
12.	Lead Apron
13.	Forcep/Tong
14.	Radiacwash & Radiac wipe  

15.	Personal Dosimeters (Quantity:4)
16.	Radioactive Sharp Pack
17.	Minor Emergency Spill Kit 
18.	Decontamination Drum