Kingston Health Sciences Centre

INPATIENT IODINE-131 RADIATION THERAPY: PATIENT CARE AND SAFETY PRECAUTIONS

LEARNING GUIDE

Kingston Health Sciences Centre
Centre des sciences de la santé de Kingston

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Date: 2002 October
Revised: 2020 August

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NOTE This learning guide contains information current at the time of publication. Policies and procedures and information are reviewed (at minimum) every 3 years. Please refer to related policies and procedures in the Nursing Policy and Procedure Manuals and in manuals related to practice in your clinical area for ongoing current information.

1.0 INTRODUCTION

The use of radiation in the treatment of cancer is based on the ability of radiation to interact with the molecules of the rapidly multiplying tumor cells to produce effects that are harmful to these cells.

This learning guide has been prepared to assist the learner in the development of the knowledge and skills required to provide nursing care for patients receiving treatment with radioactive Iodine (I-131) therapy.

The precautions to be taken by nurses while caring for patients being treated with Iodine-131 are based on:

- compliance with the Nuclear Safety and Control Act
- minimization of contamination of the patient's room
- minimization of the dose to personnel arising from gamma rays emitted by the patient
- minimization of the possibility of contamination and/or ingestion of Iodine-131 by personnel caring for the patient
- safe handling of possible spills of radioactive materials

1.1 AUTHORIZATION

To become authorized for the care of the patient undergoing radiation therapy, the nurse will:

- read the Inpatient 131 Radiation Therapy: Patient Care and Safety Precautions learning guide;
- review associated KGH radiation safety policies (please refer to Table 1 in section 4.3)
- write the written authorization tests with a passing grade of at least 80%

1.2 EXPECTED COMPETENCIES

The nursing role is important in all phases of the therapy and includes:

- pre-treatment teaching and assessment;
- treatment-phase support;
- monitoring of patient condition;
- post-treatment education and follow-up.

2.0 IONIZING RADIATION

Radiation is simply a form of energy**. Ionizing radiation is radiation which is energetic enough to break molecules apart.** When ionizing (energetic) radiation interacts with an atom, it can transfer its energy to an electron, knocking it out of orbit and thereby changing the molecule that the atom is part of.

2.1 SOURCES OF IONIZING RADIATION

Radiation is all around us, and we are exposed to ionizing radiation daily just by living on earth.

Natural background radiation consists of:

- Cosmic rays from outer space, such as the sun
- Radiation from the earth's crust, such as Radon gas
- Internal radiation from materials present in our bodies from ingesting food, such as Potassium-40

Hospital sources of ionizing radiation would include:

- Machines that generate X-rays such as CT scanners
- Cobalt-60 radiation treatments in the cancer clinic
- Radioactive tracers that emit alpha, beta and gamma rays such as the ones used in Nuclear Medicine, including I-131

2.2 EFFECTS OF IONIZING RADIATION EXPOSURE

Ionizing radiation can have detrimental effects on living things. When radiation strikes a living tissue, there can be a number of outcomes. It can:

- kill the cell, which is what happens to tumour cells using high dose radiation.
- cause a mutation or alteration in the cell's genetic material that could lead to a malignancy. This can occur with low doses of radiation received over a long period of time, such as when exposed at work.
- do nothing. There are more than a trillion atoms in our bodies and the radiation can ionize an atom that serves no crucial purpose.

It is worth keeping in mind that life has evolved in an environment that is full of background radiation and so our cells are very good at repairing damage to DNA molecules. In fact, many millions of strand breaks and other sorts of damage to DNA occur and are repaired in our cells every day.

3.0 UNITS USED WITH RADIATION

3.1 ACTIVITY

Radiation quantity is measured in the metric unit of **MegaBequerals**, which is abbreviated **MBq**. This replaces the old unit called the milliCurie, named after Marie Curie.

Treatment for thyroid cancers typically involve 3700-7400 MBq of I-131.

3.2 RADIATION DOSE

Exposure to radiation is generally measured in **milliSieverts**, which is abbreviated **mSv**.

3.3 HALF LIFE

The measurement of how long it takes for half of the radioactive atoms in a material to be decreased by 50%. After two half-lives the material would be 25% of the original activity. The time is measured in hours, days or years according to the radioactive material as some half lives are years long, while some are seconds long.

4.0 EXPOSURE LIMITS

Institutions are required by law to ensure that workers do not exceed regulated dose (exposure) limits because of diagnostic and therapeutic use of radiation.

4.1 DOSE LIMITS

Category	Limit (mSv/year)
Nuclear energy worker (NEW)	20
Other workers and members of the public	1

NEWs include people who work directly with and around radiation every day such as Nuclear Medicine Technologists, Radiological Technologists and Radiation Therapists and Oncologists.

Nuclear Medicine Technologists at KGH typically receive < 3 mSv per year occupationally.

Other staff, including most nurses, must not receive more than 1 mSv per year occupationally.

In North America, the average dose from natural sources such as the sun and earth's crust is approximately **3 mSv/year**.

4.2 DETERMINATION OF DOSE LIMITS

Exposure limits were studied and recommended by various regulatory bodies such as the International Commission on Radiation Protection (ICRP).

Occupational dose limits have been set so that the risk from radiation does not exceed the general risks associated with life.

Risk Comparison: The following table lists some doses and compares the risk to two other well-known risky activities: smoking and highway driving.

Dose (mSv)	Equivalent No. of Cigarettes	Equivalent No. of Highway km
1	300	1160
3	900	3480

The bottom row shows the risk that arises from natural background radiation that we all receive. It is as dangerous as driving from Kingston to Calgary in terms of risk of injury.

4.3 MEASURING EXPOSURE TO RADIATION

Occupational exposure can be measured using dosimeters. Instant read dosimeters can provide radiation exposure readings that staff acquire when caring for radioactive patients. Dosimeters should be worn between the waist and neck clipped with the face showing outward.

5.0 Radiation Protection Agencies/Legislation

A number of agencies are involved in radiation protection in Canada. Only the first one listed below is concerned with protection from radioactive materials.

Canadian Nuclear Safety Commission (CNSC)

The Canadian Nuclear Safety Commission (CNSC) writes and enforces regulations created under the *Nuclear Safety and Control Act (NSCA).* This act regulates nuclear energy and the use of radioactive materials.

Radiation Protection Bureau (RPB)

The RPB is the branch of Health Canada that sets X-ray safety standards for all federal public service and for workers under the Canada Labour Code.

Healing Arts Radiation Protection Act (HARP Act)

The HARP Act in Ontario was designed to regulate medical use of X-rays.

5.1 Radiation Safety Officer

Every workplace that uses radioactive material has a Radiation Safety Officer who reports directly to the CNSC. This person is responsible for ensuring the institution is following the regulations set by the CNSC, including the monitoring of occupational radiation exposure to staff members.

6.0 Properties of Radioactive Iodine-131

Iodine-131 is a radioactive form of iodine that is used in the radiation therapy of various forms of thyroid disease.

Iodine-131 emits two kinds of radiation: gamma rays and beta rays. The gamma rays are very penetrating and most of them will pass out of the patient and irradiate persons close to the patient. Beta rays only travel a few millimeters in tissue and irradiate only the tissues containing the Iodine-131, mainly the thyroid gland. Therefore, most of the radiation dose to the patient's thyroid gland comes from the beta radiation.

Iodine-131 has a half-life of 8 days.

Iodine-131 behaves just as ordinary, non-radioactive iodine in the body. When it is administered, a portion is taken up by the thyroid gland, but the majority of it is excreted very rapidly through urination in the first 24 hours after administration. It is also present in saliva and sweat.

Iodine-131 is concentrated by a fetus while in utero. **Pregnant workers should not care for I-131 patients.**

7.0 RADIATION SAFETY WHEN CARING FOR IODINE-131 PATIENTS

7.1 THE ALARA PRINCIPLE

ALARA is the guiding principle of radiation safety. It means that all exposures will be kept **As Low As Reasonably Achievable**, social and economic factors being taken into account. This means that anyone exposed to radiation should receive the lowest dose possible.

7.2 HOW TO KEEP RADIATION EXPOSURE ALARA:

Radiation exposure can be decreased using four commonsense principles:

1. **Time:** Minimize your time near the patient. With I-131 treatments, the patient is the source of radiation. So keep your time spent close to the patient as brief as possible. However, seeing to the patient's needs remains very important, so minimizing time must not compromise patient care.

2. **Distance:** Increase your distance from the patient. The dose from a radiation source falls off rapidly as distance is increased. So if you merely have to talk with the patient, do so from a greater rather than a smaller distance. For example, stand 2 meters away rather than 1 meter away.

3. **Shielding:** The walls and doors of the two rooms used for I-131 treatments (Connell 1069 and 1070) contain substantial quantities of lead to shield surrounding areas from excess radiation. The lead aprons worn in fluoroscopy suites are designed to stop diagnostic X-rays only, and will stop only a very small fraction of the gamma rays emitted by Iodine-131. Therefore these lead aprons are not recommended for use when caring for patients undergoing treatment with Iodine-131.

4. **Avoid Contamination:** Radioactive iodine is excreted in virtually all body fluids (urine, sweat and saliva), so any portion of the room occupied by the patient can become contaminated. It is most important to take sensible precautions to avoid contamination of yourself. Standard precautions against infection are adequate to achieve this. Don gloves, gowns and booties before entering the patient room and discard upon exiting.
   Any I-131 ingested will be picked up by your thyroid and irradiate it.

8.0 EMERGENCIES INVOLVING IODINE-131 PATIENTS

The Nuclear Medicine Technologist (NMT) on call, or the Radiation Safety Officer (RSO), should be contacted in the case of emergencies.

8.1 MEDICAL EMERGENCIES

Emergency measures come first. Responding staff should be kept to a minimum and should don PPE (gloves, gown, booties, and mask with shield). It is unlikely that a patient would contain a sufficient amount of radiation to be a significant hazard to the responding staff. Any fluid collection should be considered radioactive.

8.2 SPILL OF VOMIT OR EXCRETA

The Nuclear Medicine Technologist on call should be notified and supervise cleanup of any spills of urine or vomit as they could contain I-131.

8.3 EMERGENCY SURGERY OR DEATH

The Nuclear Medicine Technologist on call and the RSO should be notified immediately. In the case of death the body should not be removed from the room.

There are several policies regarding Inpatient I-131 treatments; the policies (presented in Table 1 on the following page) have been setup in a step-by-step fashion to guide the readers along the process. In summary, the policies outline

- expectations on the patient
- expectations on the health care providers,
- work flow for treatment (i.e. who sets up the room, places signs, etc..) and
- what to do in the case of emergencies.

TABLE 1: Summary of policies regarding Inpatient I-131 treatments. Policies are found on the KHSC Intranet under the CNSC NSRD Radiation Safety Manual.

Step	Policy # 08.	POLICY NAME - Description[1]:	Location (click hyperlink below):
a)	100	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) OVERVIEW** Summary of theI-131 In-patient pertinent policies.	Policy
b)	101	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) PATIENT EDUCATION** Describes the requirements for educating the patient regarding their treatment, and outlines the hospital's expectations of patients and visitors during their stay.	Policy Booklet
c)	102	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) ROOM PREPARATION, SIGNAGE AND DECOMMISSIONING** Defines the requirements for room preparation and room decommissioning, prior to and after treatment.	Policy
d)	103	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) HEALTH CARE PROVIDERS** Describes the procedures and restrictions for staff members involved in the treatment (in nursing, nuclear medicine and environmental services).	Policy
		Health Care providers (i.e.; nursing, nuclear medicine and environment staff) MUST be familiar with radiation safety policy 02.102 Personal Dosimetry and Action Levels.	Policy
e)	104	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) TREATMENT COURSE** Describes the procedures for administering the treatment, outlines safe practice while the patient is in the room, and describes required documentation	Policy
f)	105	**INPATIENT I-131 THERAPY (ACTIVITY > 1.1 GBQ) EMERGENCIES** States protocols to follow in the event of an emergency such as spillage, surgery, death, etc.	Policy

5.0 Advanced Comp. TEST: Radiation Therapy

On the following answer sheet, circle the letter indicating the correct phrase that completes each of the following.

1. Ionizing radiation:
    a. comes from x-ray machines
    b. comes from outer space
    c. ionizes atoms and molecules
    d. All of the above

2. The effective dose limit for a Nuclear Energy Worker (NEW) is
    a. 100 mSv/year
    b. 20 mSv/year
    c. 4 mSv/year
    d. 1 mSv/year

3. The effective dose limit for a nurse who is not designated as a Nuclear Energy Worker is
    a. 50 mSv/year
    b. 20 mSv/year
    c. 4 mSv/year
    d. 1 mSv/year

4. The Nuclear Safety and Control Act is enforced by the
    a. Canadian Parliament
    b. Radiation Protection Bureau of Health Canada
    c. HARP Act in Ontario
    d. Canadian Nuclear Safety Commission

5. The half-life of Iodine-131 is
    a. 8 years
    b. 8 weeks
    c. 8 days
    d. 131 days

6. The items and surfaces the patient may come in contact with after the I-131 therapy has been administered must be covered to
    a. absorb any spills that might occur
    b. decrease the amount of spread contamination
    c. prevent the item/surface from becoming contaminated with Iodine-131
    d. all of the above

7. Most of the Iodine-131 administered to patients is
    a. excreted within the first few days
    b. retained in the thyroid
    c. converted to other elements

d. retained in organs other than the thyroid

8. Radioactive iodine is excreted
   a. only in the urine
   b. only in feces
   c. in all bodily fluids
   d. only in saliva and sweat

9. The strategy that will give you the lowest dose of radiation from the patient is
   a. minimizing your time and distance from the source
   b. minimizing your time and maximizing your distance from the source
   c. maximizing your distance and increasing your time near the source
   d. maximizing your distance from the source and the time does not matter

10. In dealing with patients treated with Iodine-131, it is important to avoid contaminating yourself with radioactive iodine because
   a. most of the dose you receive is from gamma rays emitted by the patient
   b. any ingested Iodine-131 will go to the thyroid and irradiate it
   c. you may acquire an infection from the patient
   d. any ingested Iodine-131 will go to the bone marrow

11. The Radiation Safety Officer (RSO) or the Nuclear Medicine Technologist on call must be contacted if
   a. the patient has a medical emergency
   b. the patient vomits somewhere other than the toilet
   c. if a urine sample is taken
   d. all of the above

12. The strategy that will promote excretion and reduce the patient's radioactivity level most quickly is
   a. encouraging the patient to suck on sour candies
   b. encouraging the patient to shower daily
   c. encouraging the patient to drink plenty of fluids
   d. instructing the patient to wear gloves when using objects in the room

13. Nurses that care for I-131 therapy patients
   a. must be authorized by the hospital
   b. may not be pregnant
   c. must know how to reduce their radiation exposure
   d. all of the above

14. ALARA stands for
   a. America Light and Radiation Act
   b. As Low As Reasonably Achievable
   c. All Limits Are Reasonably Achievable

d. All Light and Rays Act

15. Before entering the I-131 patient room personnel should don:
    a. protective booties, gloves and gown
    b. lead apron
    c. eye protection
    d. all of the above

16. Once an I-131 therapy patient is discharged the room
    a. gets cleaned immediately by environmental services
    b. gets decommissioned for radioactivity by Nuclear Medicine
    c. is only used again by an I-131 therapy patient
    d. is left empty for 1 week before being used again

Answer Sheet for Take Home Test for Radiation Therapy

Name _____ **Date** _____

1. a b c d

2. a b c d

3. a b c d

4. a b c d

5. a b c d

6. a b c d

7. a b c d

8. a b c d

9. a b c d

10. a b c d

11. a b c d

12. a b c d

13. a b c d

14. a b c d

15. a b c d

16. a b c d

8.0 REFERENCES

Please refer to Table 1.

Please refer to CNSC regulations including:

Nuclear Safety and Control Act	http://laws-lois.justice.gc.ca/eng/acts/N-28.3/index.html
General Nuclear Safety and Control Regulations	http://laws-lois.justice.gc.ca/eng/regulations/sor-2000-202/page-1.html
Radiation Protection Regulations	http://laws-lois.justice.gc.ca/eng/regulations/sor-2000-203/page-1.html

10.0 EVALUATION OF LEARNING GUIDE

Your feedback and comments are most appreciated. Thank you for your time in responding to this questionnaire. It will help us in planning/revising learning materials.

Circle appropriate response	Strongly agree				Strongly disagree
1. The content was clear and easy to understand.	1	2	3	4	5
Comments:					
2. The content was relevant.	1	2	3	4	5
Comments:					
3. My learning needs were met.	1	2	3	4	5
Comments:					
4. This guide (and referenced policies) will help me to meet the knowledge/skill require-ments necessary to care for patients receiving I-131 treatment.	1	2	3	4	5
Comments:					

Additional comments/suggestions:

Please return completed evaluation to your Clinical Learning Specialist.

Thank you.