



Ordre des technologues
en **imagerie médicale**,
en **radio-oncologie** et en
électrophysiologie médicale
du Québec

ENTRY-LEVEL PROFIL



Radiation oncology
TECHNOLOGIST

**Ordre des technologues en imagerie médicale,
en radio-oncologie et en électrophysiologie médicale du Québec
(OTIMROEPMQ)**
6455 Jean-Talon Street East | Suite 401
Saint-Léonard, QC H1S 3E8
Telephone: 514-351-0052 | 1-800-361-8759 | Fax: 514-355-2396

Note:

- In order to correctly interpret this profile, it is recommended to read the document in its entirety and to refer to the "Code de déontologie" and the general and specific standards of practice.

Any reproduction, in whole or in part, of this document is authorized on condition that the source is acknowledged: **Ordre des technologues en imagerie médicale, en radio-oncologie et en électrophysiologie médicale du Québec (OTIMROEPMQ)**.

TABLE OF CONTENTS

INTRODUCTION	6
PROFESSIONAL ATTITUDE	8
A : PROFESSIONAL PRACTICE.....	10
A-1: Demonstrate critical thinking	10
A-2: Demonstrate professional behaviour.....	11
A-3: Help deliver training and practical instruction	11
B : RESPECT HEALTH AND SAFETY PRINCIPLES.....	13
B-1: Manage risks associated with equipment and work areas	13
B-2: Manage risks associated with the patient.....	14
B-3: Apply the principles of ergonomics	14
B-4: Control infections.....	15
C : PERFORM QUALITY CONTROL	16
C-1: Assess equipment performance	16
D : PATIENT MANAGEMENT	17
D-1: Greet patient's in a professional manner.....	17
D-2: Analyze the patient's prescription and chart.....	18
D-3: Explain the examination to the patient and/or companion.....	18
D-4: Manage priorities.....	19
D-5: Ensure the patient's radiation protection	19
D-6: Ensure the patient's follow-up	20
E : UNDERSTAND HUMAN SYSTEMS AND GENERAL PRINCIPLES OF CANCEROLOGY	21
E-1: Demonstrate an understanding of the human body systems	21
F : CARRY OUT TREATMENT PLANNING	22
F-1: Choose and devise positioning and/or immobilization accessories.....	22
F-2: Devise beam modifying accessories.....	22
F-3: Administer contrast media and drugs.....	23
F-4: Use various imaging devices to carry out planning	23
F-5: Carry out planning using CT.....	24
F-6: Carry out planning using MRI.....	24
G : PERFORM DOSIMETRY PLANNING.....	25

G-1: Produce optimal dosimetry based on the technical parameters established during planning	25
H : CARRY OUT EXTERNAL BEAM RADIATION THERAPY TREATMENTS	26
H-1: Position the patient.....	26
H-2: Position the treatment machine	26
H-3: Check data	26
H-4: Perform irradiation	27
H-5: Ensure follow-up of chart	27
I : CARRY OUT PLANNING AND BRACHYTHERAPY TREATMENT	28
I -1: Carry out planning for brachytherapy	28
I -2: Provide patient care	29
I -3: Carry out brachytherapy treatment with sealed sources.....	29
I-4: Carry out brachytherapy treatment with unsealed sources.....	30
APPENDIX 1: ABBREVIATIONS, PREFERRED TERMS AND DEFINITIONS	31
APPENDIX 2: TAXONOMY	40
BIBLIOGRAPHY	42

INTRODUCTION

This document describes the specific qualifications that a radiation oncology technologist must have when entering the profession. It is intended for candidates who wish to write the OTIMROEPMQ certification exam and for members Exam committee.

The entry-level profile serves as a reference in order to provide direction to future technologists as they prepare for certification. It also guides the development of the scenarios used in the entrance exam. It is important to note that these scenarios represent the work performed by the technologist in real life and are intended to assess candidates' competency level and their ability to apply their theoretical knowledge to every day practice.

Also, the competencies included in the entry-level profile match the training requirements prescribed by the ministerial notice.

According to the Ministère de l'Enseignement supérieur, de la Recherche et Science (1998),

“Graduates of the radiation oncology technology program competently and professionally carry out all the tasks related to radiation therapy. Also, when it comes to putting into practice the competencies associated with treatment planning, the graduates apply basic simulation and dosimetry techniques.

These technologists perform their profession only in a hospital setting, as part of a multidisciplinary team. In order to obtain their licence to practice, graduates must satisfy the conditions set out by the *Ordre des technologues en imagerie médicale, en radio-oncologie et en électrophysiologie médicale*.

In addition to the important scientific and technical aspect, where working precision and correct calculations are crucial, these technologists develop and maintain special relationships with patients with cancer throughout the duration of their treatment”

This document was based on the 2006 CAMRT’s national competency profile, an analysis of the work environment carried out by the Order in 2003, and the Order’s “Final Objectives”. It also takes into consideration the *Act respecting medical imaging technologists, radiation oncology technologists and medical electrophysiology technologists*, regulations and the standards of practice for medical imaging technologists and radiation oncology technologists.

The Order’s general standards of practice describe the competency of their members as follows: “Competency is not measurable in itself, but is expressed through specific actions or elements that can be measured. Competency comes from a group of elements that essentially fall under the heading of *ability*. However, this one word contains many facets. We must agree that a person is competent if that person is *capable* of unifying his or her actions by mastering a reasonable number of the elements listed below.

Thus we must be able to observe in a professional, the ability to :

- Acquire knowledge;
- Keep this knowledge updated;
- Apply this knowledge to real-life work situations;
- Judge and self-evaluate;
- Communicate and interact;
- Manage stress in the workplace.

These elements challenge the physical, emotional, and intellectual aspects of a human being.”
(p. 6)

The first section of the document presents the professional attitude, describing specific skills that a technologist must assess. The following section lists specific competencies grouped by theme. Please note that emphasis is placed on the critical thinking and technical skills that a radiation oncology technologist entering the profession must develop in order to work in partnership with the patient and other professionals on the multidisciplinary team. The level of skill proficiency has been established based on Bloom’s Taxonomy (see Appendix 2).

Finally, at the end of the document, you will find two appendices (abbreviations, preferred terms and a few definitions, and Bloom’s Taxonomy) as well as a bibliography listing the references governing the profession.

PROFESSIONAL ATTITUDE

This section is intended to identify specific attitudes that a technologist entering the profession must have. It is intrinsic to the routine practice of Radiation oncology technologists and applies to all sections of this document.

AUTONOMY

- Show initiative
(acknowledge and be mindful of work to be done)
- Prioritize and accomplish tasks efficiently in all situations
(medical emergencies, failed equipment...)
- Recognize one's limits and be able to seek help from the appropriate people in order to properly manage any given situation
- Demonstrate good judgment
- Be organized, responsible and methodical

ADAPTATION AND MULTIDISCIPLINARY INTEGRATION

- Establish a relationship of trust with various encounter
(co-workers, oncologists, nurses...)
- Become a part of the work team
(adapt to the way co-workers and supervisors do things...)
- Establish a relationship of respect with peers and the multidisciplinary team
- Adapt to changes
(team, technological advances, specialties...)
- Manage stress

VERBAL AND NON-VERBAL COMMUNICATION

- Have the ability to communicate clearly, precisely and according to the client
- Develop trust
(with the patient, team...)
- Is empathetic, patient, respectful and available
- Have good listening skills and be open toward others
(with patients, co-workers...)
- Control one's emotions while performing daily tasks
- Use verbal and non-verbal communication that is compatible with the professional ethics.
- Express oneself in a constructive manner

COMMITMENT TO THE PROFESSION

- Be interested and motivated
(conferences, current events...)
- Demonstrate intellectual and scientific curiosity and in one's area of expertise
(commitment, critical thinking regarding one's work...)
- Keep one's knowledge up-to-date
- Show attention to detail, is meticulous
- Be rigorous

RULES, ETHICS AND CODE OF ETHICS

- Show ethical behaviour
(with the patient, peers, supervisors...)
- Comply with the various acts, regulations, rules and standards
- Respect confidentiality, be discrete
- Be vigilant
- Adopt safe work methods with patient, co-workers and one-self

COMPETENCY STATEMENTS

A - PROFESSIONAL PRACTICE

N.B. The competency “Professional Practice” is intrinsic to the routine practice of radiation oncology technologists and applies to all sections in this document.

A-1: DEMONSTRATE CRITICAL THINKING

- 1.1 Consider the patient's condition and the availability of material when prioritizing examinations**
(review the work schedule, communicate with other health professionals responsible for the patient, ensure the material is available...)
- 1.2 Consider all the elements that could influence the planning and treatment**
(general anatomy, topography, physiology, pathology, prescription, previous exams, contraindications, equipment, interdisciplinary professionals involved...)
- 1.3 Adapt procedures based on elements influencing planning and treatment**
(prescription, patient's condition, images and reports from previous exams and related disciplines, faulty equipment...)
- 1.4 Optimize outcomes based on the work context, while respecting the protocols of the establishment to ensure optimal quality of the services provided to patients**
(exams, treatments, procedures...)
- 1.5 Determine the purpose of the procedure**
(images, patient, health professionals, examination context...)
- 1.6 Apply problem-solving strategies**
- 1.7 Apply stress management techniques**
- 1.8 Apply conflict resolution techniques**

A-2: DEMONSTRATE PROFESSIONAL BEHAVIOUR

- 2.1 **Practice in accordance with legislation, rules, and current standards of practice**
(discretion, confidentiality, professional attitude, personal appearance that inspires respect and trust...)
- 2.2 **Act only according to an individual or collective prescription signed by a professional entitled to do so by the law**
- 2.3 **Demonstrate an attitude that is compliant with the standards of professional conduct**
(avoid private conversations among colleagues, avoid giving impressions or making comments and remarks, preserve the patient's dignity...)
- 2.4 **Show respect and sensitivity in both patient and professional interactions**
(stress management, conflict resolution, adapting to change in the work environment...)
- 2.5 **Prepare the required locations, equipment, material and accessories before taking the patient into the room**
- 2.6 **Apply an optimal work method based on the context**
(patient's condition, material availability, maximization efficiency...)
- 2.7 **Continually participate in personal professional development**
- 2.8 **Develop a scientific mind**
(problem-solving, nomenclature, terminology, curiosity, critical thinking...)
- 2.9 **Participate in human and material resource management to ensure one's work station runs smoothly**
- 2.10 **Exchange relevant information and perform tasks in good faith, in the patient's best interest to promote a good collaboration among professionals**
- 2.11 **Provide the health professionals involved with relevant information reviewing the patient's chart and meeting with the patient**
- 2.12 **Help update technical procedures**
- 2.13 **Participate in the elaboration of new planning and treatment techniques**
- 2.14 **Add one's electronic signature to sign off on the information and comments appearing on a patient's record or an electronic request**

A-3: HELP DELIVER TRAINING AND PRACTICAL INSTRUCTION

- 3.1 **Explain the general functioning of the department**
- 3.2 **Explain the treatment and planning procedures**
- 3.3 **Explain the functioning of the devices and equipment**
- 3.4 **Participate in theoretical and practical teaching**
- 3.5 **Take part in trainee evaluations**

B - RESPECT HEALTH AND SAFETY PRINCIPLES

N.B. “Respect health and safety principles” applies to each section in this document.

B-1: MANAGE RISKS ASSOCIATED WITH EQUIPMENT AND WORK AREAS

- 1.1 Apply the standards for occupational health and safety and the quality assurance program**
(WHMIS, MPSP, OH&S, globally harmonized system (GHS)...))
- 1.2 Apply the establishment's emergency measures plan**
(emergency codes, incidents...)
- 1.3 Check emergency tray and cart**
(expiry date, location...)
- 1.4 Handle biomedical, chemical and pharmaceutical waste according to established standards**
- 1.5 Draw attention to any faulty equipment or material**
- 1.6 Maintain a clean and safe work environment**
- 1.7 Check safety devices**
(door interlock, emergency buttons...)
- 1.8 Ensure proper storage of equipment and material**
(lead apron, immobilization material...)
- 1.9 Record any event related to an incident or accident**
(chart, register, AH-223 form...)

B-2: MANAGE RISKS ASSOCIATED WITH THE PATIENT

- 2.1 Apply sterile work methods**
- 2.2 Provide clinical care in relation to the treatment and its planning**
- 2.3 Apply strategies that address emergency situations**
(patient's vital signs, CPR, agitated patient, emergency measures...)
- 2.4 Monitor the parameters for ancillary devices**
(sphygmomanometer, oxygen, saturometer...)
- 2.5 Apply immobilization techniques adapted to the patient's age and condition**
- 2.6 Utilize safe transfer techniques based on the patient's condition**
(MPSP, transfer in fracture cases...)
- 2.7 Handle accessories in a way that does not harm the patient**
(tubes, oxygen, lines...)
- 2.8 Ensure patient's comfort and safety**
(immobilization, blanket, pillow, neck brace...)
- 2.9 Maintain visual and auditory contact with the patient at times**
(avoid injuries, ensure radiation protection, ensure clinical monitoring...)
- 2.10 Follow preventive procedures for immuno-suppressed patients**
- 2.11 Apply established measures to control risks that could harm the patient**
(human error, mechanical defects, technological breakdown, contingency plan...)
- 2.12 Enter the data in the patient's chart**
(technical factors, pregnancy, patient's condition, contrast medium, allergy, incident, accident, form AH-223...)

B-3: APPLY THE PRINCIPLES OF ERGONOMICS

- 3.1 Adopt ergonomic work postures**
- 3.2 Use ergonomic transfer techniques for moving patients or equipment**
- 3.3 Maintain a safe and ergonomic work area**

B-4: CONTROL INFECTIONS

- 4.1 Safely handle pointed or sharp objects, contaminated material and biomedical waste safely**
- 4.2 Dispose of pointed or sharp objects, contaminated material and biomedical waste appropriately**
- 4.3 Prevent the transmission of infections at all times by applying basic infection control methods according to the established procedures**
(changing beds, washing hands, wearing gloves and a mask...)
- 4.4 Prevent the transmission of infections by applying additional precautions according to the established procedures**
(personal protection clothing, N95 mask...)
- 4.5 Apply infection control techniques to prevent the transmission of micro-organisms for equipment and examination rooms**
(disinfecting lines, washing tables...)
- 4.6 Prioritize actions based on infection prevention**

C - PERFORM QUALITY CONTROL

N.B. Quality assessment applies to each of the points described in sections F, G, H, I and J of this document.

C-1: ASSESS EQUIPMENT PERFORMANCE

- 1.1 Apply personal knowledge to operate equipment properly**
- 1.2 Apply quality control measures according to manufacturer's schedules**
(manufacturer's standard, safety code 35, internal procedures...)
- 1.3 Communicate quality control test results and issues clearly and accurately**
- 1.4 Record data and test results**
- 1.5 Take the necessary measures to make corrections when a test irregularity is encountered**
(stop the procedure, advise the coordinator, change the parameters...)
- 1.6 Help create and update technical files, quality control protocols and maintenance procedures**
(monitors, work stations...)
- 1.7 Perform a daily general inspection of each device**
(visual inspection, auditory inspection...)

D - PATIENT MANAGEMENT

N.B. Patient management applies to each of the points described in sections F, G, H, I and J of this document.

D-1: GREET PATIENT'S IN A PROFESSIONAL MANNER

- 1.1 **Verify the patient's identity using at least two indicators**
- 1.2 **Introduce oneself to the patient and clearly identify one's profession**
- 1.3 **Establish the patient's spoken language and use proper terminology; if needed, request the presence of, or consult, with an interpreter.**
- 1.4 **Evaluate the patient's cognitive, physical and mental condition**
- 1.5 **Validate patient preparation**
- 1.6 **Establish a climate of trust**
(visual contact, active listening, empathy...)
- 1.7 **Respect the patient's privacy**
(close the door to the examination room, validate the questionnaire in a private place, cover the patient...)
- 1.8 **Verify with the patient the accuracy of the written information on the prescription for the treatment or examination or procedure to be performed with the patient**
- 1.9 **Act in accordance with the code of ethics to avoid any behaviour that would be open to interpretation or imply intimacy**
(sexual, psychological...)
- 1.10 **Act according to the patient's cognitive, psychological, and physical condition throughout all aspects of the patient's care**

D-2: ANALYZE THE PATIENT'S PRESCRIPTION AND CHART

- 2.1 **Verify the conformity of the prescription**
(signature, relevance of the requested examination, contraindications any missing data, patient's name, date...)
- 2.2 **Analyze the information on the prescription in preparation for performing the planning or treatment**
(clinical information, examination requested...)
- 2.3 **Prepare the chart based on the scheduled planning and treatment**
- 2.4 **Verify the patient's radiotherapy chart and the medical chart**
- 2.5 **Demonstrate an understanding of reports and previous images from related disciplines**
- 2.6 **Correct any mistakes that may have been made in the patient's chart**
- 2.7 **Ensure confidentiality when compiling information relevant to the planning and treatment**
(medical history questionnaire, medical and radiological chart, preparation...)

D-3: EXPLAIN THE EXAMINATION TO THE PATIENT AND/OR COMPANION

- 3.1 **Give clear explanations of the examination or treatment based on the patient's condition and need for information**
- 3.2 **Explain the goal of administering any drugs and/or contrast material, as well as any possible side effects**
- 3.3 **Validate the contraindications to any aspect of the examination and treatment**
(medical history questionnaire, pregnancy...)
- 3.4 **Describe the sequence of events that will take place during examination and treatment**
- 3.5 **Teach the appropriate care according to the site to be treated**
- 3.6 **Provide instructions and guidelines to promote an accurate and successful planning and treatment procedure**
- 3.7 **Reassure the patient with regards to the role, proximity and movements of the machine**
- 3.8 **Provide instructions for radiation protection**
- 3.9 **Answer the patient's questions**
- 3.10 **Validate the patient's understanding**
- 3.11 **Inform the patient about the follow-up of his/her chart**
- 3.12 **Have the patient remove any object or clothing that may compromise the quality of the planning or treatment**
- 3.13 **Ensure that the patient agrees to having the planning and treatment**

D-4: MANAGE PRIORITIES

- 4.1 **Establish and update the order of priorities**
- 4.2 **Make sure patients are available and prepared as required**
- 4.3 **Advise any other involved services to prepare patients and synchronize procedures**
- 4.4 **Reorganize the work schedule appropriately around emergencies**
(emergency, intensive care patients...)
- 4.5 **Coordinate patient transport**
(patients admitted to hospital or residing at other healthcare institutions)

D-5: ENSURE THE PATIENT'S RADIATION PROTECTION

- 5.1 **Apply techniques and work methods that reduce radiation exposure (ALARA) while ensuring the quality of the examination or treatment**
(patient preparation, technical parameters, positioning, collimation, patient is of the age to procreate, lead apron...)
- 5.2 **Apply knowledge of the effects and risks associated with ionizing radiation**
- 5.3 **Help teach radiation protection measures required for the safety of patients, the environment, the general public, and other health care professionals**
- 5.4 **Give the patient clear instructions on the importance of his/her position in order to optimize radiation protection**
- 5.5 **Provide the patient with information useful for his/her protection as well as for the protection of others**
- 5.6 **Apply the necessary radiation protection measures to ensure the safety of the environment, the general public and other healthcare professionals**
(close the door to the room...)
- 5.7 **Evaluate the need to repeat the planning**
- 5.8 **Identify the role of various radiation protection authorities**
(ICRP, RPB, CECR...)
- 5.9 **Follow the National Dosimetry Services (Health Canada) guidelines for the proper use and the precautions to take with dosimeters**
(thermoluminescent, OSL, dosimeter...)

D-6: ENSURE THE PATIENT'S FOLLOW-UP

- 6.1 Coordinate the patient's various (applicable) appointments**
(doctors, other professionals, radiotherapy scheduling modifications, confirm the patient's next appointment in the department)
- 6.2 Record relevant observations and data in the patient's chart**
- 6.3 Communicate relevant information to other professionals involved**
- 6.4 Give to the patient the appropriate instructions or recommendations to follow after planning and treatment**
- 6.5 Provide the patient information's regarding available resources**
(explanatory sheets, CLSC, specialists...)
- 6.6 Give the appropriate post-planning or post-treatment recommendations**
- 6.7 Ensure the patient receives follow-up**

E - UNDERSTAND HUMAN SYSTEMS AND GENERAL PRINCIPLES OF CANCEROLOGY

E-1: DEMONSTRATE AN UNDERSTANDING OF THE HUMAN BODY SYSTEMS

- 1.1 Apply knowledge of human anatomy and physiology**
- 1.2 Apply knowledge of cancerous tumours, their dissemination, and their staging**
- 1.3 Apply knowledge of radiobiological effects and tissue radiosensitivity**

F - CARRY OUT TREATMENT PLANNING

N.B. For this planning section, the work processes described in sections A, B and C apply at all times. This section describes the specific aspects of the treatment planning only.

F-1: CHOOSE AND DEVISE POSITIONING AND/OR IMMOBILIZATION ACCESSORIES

- 1.1 Optimize the patient's position to ensure that the area to be treated is readily accessible (accuracy and reproducibility...)**
- 1.2 Use anatomical landmarks to clinically align the patient**
- 1.3 Analyze the impact of using different immobilization techniques**
- 1.4 Make the immobilization accessories**
- 1.5 Adjust immobilization accessories, if necessary**
- 1.6 Take a picture of the positioning, as required**
- 1.7 Identify and label the accessory appropriately**
- 1.8 Record the data in the patient's chart**

F-2: DEVISE BEAM MODIFYING ACCESSORIES

- 2.1 Apply the safety rules in force, wear appropriate equipment, use safe material and ensure the safety of the patient at all times**
- 2.2 Fabricate and mount shielding blocks**
- 2.3 Prepare the templates for the positioning of shielding blocks**
- 2.4 Fabricate electron cut-outs**
- 2.5 Prepare bolus**

F-3: ADMINISTER CONTRAST MEDIA AND DRUGS

- 3.1 Verify all the material used for injections and report any irregularity that could compromise the quality of the procedure**
(expiry date...)
- 3.2 Select the material specifically intended for each of the various procedures**
(puncture, perfusion, injection, ...)
- 3.3 Fill out the medical history questionnaire**
- 3.4 Consider the pharmacological characteristics of the administered drugs and their interactions**
- 3.5 Administer contrast media and drugs according to established procedures**
- 3.6 Intervene appropriately in the case of an adverse reaction to contrast media or drugs**
(extravasation, allergies,...)

F-4: USE VARIOUS IMAGING DEVICES TO CARRY OUT PLANNING (CT, SIMULATOR AND MRI)

- 4.1 Select the procedure and the appropriate technical parameters for the patient's position**
- 4.2 Position the patient according to the area being treated in order to optimize treatment**
(or according to the position determined with previous imaging, when applicable)
- 4.3 Position the appropriate markers on the patient**
- 4.4 Produce images and slices that meet essential planning criteria, including the anatomical structures to be treated as well as any critical structures in the area**
- 4.5 Optimize the quality of the planning**
(visualization of anatomical structures, image quality, contrast media, air, liquid, bolus, markers...)
- 4.6 Mark and/or tattoo the reference points on the patient**
(tattoos, drawings...)

F-5: CARRY OUT PLANNING USING CT

- 5.1 **Select the appropriate imaging protocol based on the requested examination**
- 5.2 **Enter the information needed to perform the examination into the computer**
(patient demographics, patient orientation, name of the radiation oncologist supervising the examination, name of the technologist performing the examination...)
- 5.3 **Perform centering using the lasers in such a way that:**
 - The initial point of the scout-view image appropriate for the area to be examined;
 - The structures of interest are projected in the centre of the screen (adjust field of view);
 - The scout-view image covers the area of interest only.
- 5.4 **Accurately select the slices to be acquired according to the established procedure**
- 5.5 **Apply the protocols for image processing and reconstruction**
- 5.6 **Manipulate the digital images appropriately in order to enhance or maintain examination quality**

F-6: CARRY OUT PLANNING USING MRI

- 6.1 **Apply all the safety standards attributed to MRI to ensure protection**
(controlled access to the room, ferromagnetic objects, consent form...)
- 6.2 **Apply knowledge of the effects and risks associated with the magnetic field**
- 6.3 **Select the appropriate coil for the examination and use it according to the manufacturer's standards**
(flat planar coil, intracavity coil...)
- 6.4 **Select the appropriate slices/volume to image according to the requested procedure**
- 6.5 **Evaluate the quality of the image sequences**
(contrast, resolution, noise, movement, artefacts...)
- 6.6 **Reconstruct the images according to the established protocol**
(2D, 3D)

G - PERFORM DOSIMETRY PLANNING

N.B. For each of the following points, the work processes described in sections **A, B and C** apply at all times. This section describes the specific aspects of dosimetry only.

G-1: PRODUCE OPTIMAL DOSIMETRY BASED ON THE TECHNICAL PARAMETERS ESTABLISHED DURING PLANNING

- 1.1 Analyze all imaging while taking heterogeneity into account**
(X-ray, CT, MRI, PET, any contrast media administration ...)
- 1.2 Outline the anatomical structures and organs at risk (OAR) for the dosimetric calculations according to the protocol**
- 1.3 Determine the beam geometry while taking into account the physical limitations of the machine and any previous delivered dose**
(isocentre, size of treatment field, incidences, bolus, ...)
- 1.4 Determine the parameters for an optimal dose distribution**
- 1.5 Analyze the plan in consultation with the treating radiation oncologist**
- 1.6 Produce all the necessary documents required to prepare and begin the treatments**
- 1.7 Perform calculations for various radiation therapy procedures**
- 1.8 In the event that the patient has previously received treatment in the same area, compile the previous doses and adapt the plan according to the tolerance dose of critical organs**

H - CARRY OUT EXTERNAL BEAM RADIATION THERAPY TREATMENTS

N.B. For each of the following points, the work processes described in sections **A, B, C and D** apply at all times. This section describes the specific aspects of external beam radiation therapy only.

H-1: POSITION THE PATIENT

- 1.1 Reproduce all the aspects at the planning position exactly**
(physical preparation of the patient, patient alignment, the use of immobilization techniques and moulds...)
- 1.2 Use the beam modifying accessories as planned**
(filter, blocks, bolus, MLC...)
- 1.3 Verify the position through imaging**
(CBCT, kV-kV, portal imaging, under US guidance ...)
- 1.4 Analyze the images and make any necessary adjustments**

H-2: POSITION THE TREATMENT MACHINE

- 2.1 Verify that the treatment machine parameters correspond with the treatment plan, prio to the start of irradiation**
(reference field, treatment field)
- 2.2 Use the required measurement and precision tools**
(optical distance indicator)
- 2.3 Use good judgment when making adjustments**
- 2.4 Ensure that there is no risk of collision before beginning treatment**

H-3: CHECK DATA

- 3.1 Verify that the parameters manually entered into the record and verify system correspond with the planning parameters**
- 3.2 Verify the computer parameters before each irradiation run**

H-4: PERFORM IRRADIATION

- 4.1 Produce and analyze radiological verification images**
- 4.2 Deliver the treatment according to radiation Oncologist's prescription**
- 4.3 Apply the principles of safety and radiation protection by adapting work methods for given situations**
(constantly monitor the patient to ensure correct positioning and immortalization console where the irradiation parameters are visualized and do so right up to the end of treatment)
- 4.4 Compile and sign treatment doses daily**
(paper or electronic)
- 4.5 Follow the treatment plan diligently, considering that the anatomical data may change significantly over the course of treatment (e.g., weight loss) thus compromising dose delivery and treatment**

H-5: ENSURE FOLLOW-UP OF CHART

- 5.1 Ensure the approval of images according to the established protocol**
- 5.2 Ensure follow-up of information and material with health professionals**
- 5.3 Ensure daily follow-up of variations in the patient's condition and record this in the chart**
- 5.4 Ensure daily follow-up of technical variations and record these in the chart**
(SSD, non-concordance of the beam...)
- 5.5 Perform weekly patient chart reviews / QA**

I - CARRY OUT PLANNING AND BRACHYTHERAPY TREATMENT

N.B. For each of the following points, the work processes described in sections **A, B, C and D** apply at all times. This section describes the specific aspects of brachytherapy treatment only.

I-1: CARRY OUT PLANNING FOR BRACHYTHERAPY

- 1.1 Prepare the room, the material and the required products**
- 1.2 Install the equipment used to monitor the patient**
(saturometer, sphygmomanometer, cardiac monitor...)
- 1.3 Account for all materials used**
- 1.4 Prepare hospital room, if necessary**
(lead shielding, medical material, radioactivity warning signs, radioactivity area log book of visitor and staff comings and goings, radiation level measurements...)
- 1.5 Assist the radiation oncologist**
- 1.6 Perform the simulation when applicable**
- 1.7 Produce radiological images, if required**
- 1.8 Verify treatment time calculations**
- 1.9 Record the treatment parameters in the chart**
- 1.10 Perform quality control of dummy and radioactive**
- 1.11 Monitor inventories of sterile material and brachytherapy material**

I -2: PROVIDE PATIENT CARE

- 2.1 Take reference vital signs**
- 2.2 Position the patient appropriately to the desired procedure**
- 2.3 Monitor the patient**
(medication, clinical and electrophysiological signs of distress)
- 2.4 Administer the appropriate care and give the appropriate recommendations**
- 2.5 Inform the patient as to the risks he/she may represent to others, when applicable**
- 2.6 Ensure the patient receives follow-up**

I -3: CARRY OUT BRACHYTHERAPY TREATMENT WITH SEALED SOURCES

- 3.1 Connect the catheters or applicators to the afterloader**
- 3.2 Verify the treatment parameters**
- 3.3 Verify that the catheters correspond to the channels of the afterloader**
- 3.4 Prepare the afterloader according to the treatment procedure**
- 3.5 Administer the treatment**
- 3.6 Record the treatment parameters in the chart**
- 3.7 Follow radiation protection rules**
- 3.8 Disconnect catheters or applicators from the treatment device**
- 3.9 Clean the treatment area**
- 3.10 Use an appropriate radiation monitor to verify the absence of radiation before the patient leaves**

I-4: CARRY OUT BRACHYTHERAPY TREATMENT WITH UNSEALED SOURCES

- 4.1 Manage radioactive material inventory**
- 4.2 Prepare the necessary sources according to the prescription, the measurements, the calculations, and the localization plan pre-approved by the radiation oncologist.**
- 4.3 Apply the ALARA principle**
- 4.4 Apply and retract the sources**
- 4.5 Follow the procedures with respect to the storage and maintaining or inventory of the radioactive substances**
- 4.6 Ensure follow-up for brachytherapy patients injected with a radiopharmaceutical or implanted with sources on an outpatient basis**
- 4.7 Perform decontamination**
- 4.8 Store and eliminate radioactive waste safely and appropriately**

APPENDIX 1: ABBREVIATIONS, PREFERRED TERMS AND DEFINITIONS

ORGANIZATIONS

AMSMNQ	Association des médecins spécialistes en médecine nucléaire du Québec
CAMRT	Canadian Association of Medical Radiation Technologists.
CAR	Canadian Association of Radiologists (Association canadienne des radiologistes)
CECR	Centre d'expertise clinique en radioprotection
CHSLD	Centre d'hébergement et de soins de longue durée
CHU	Centre hospitalier universitaire
CISSS	Centre intégré de santé et de services sociaux
CIUSSS	Centre intégré universitaire de santé et de services sociaux
CMA	Canadian Medical Association
CNSC	Canadian Nuclear Safety Commission
CSSS	Centre de santé et services sociaux
CSST	Commission de la santé et sécurité au travail
ICRP	International Commission on Radiological Protection
MESRS	Ministère de l'enseignement supérieur, de la recherche et de la science
MIDI	Ministère de l'immigration, de la diversité et de l'inclusion
MSSS	Ministère de la santé et des services sociaux
OQLF	Office québécois de la langue française
OTIMROEPMQ	Ordre des technologues en imagerie médicale, en radio-oncologie et en électrophysiologie médicale du Québec
RPB	Radiation Protection Bureau
RSNA	Radiological Society of North America
SNM	Society of Nuclear Medicine

EQUIPMENT, EXAMINATIONS AND RADIATION PROTECTION

AEC	Automatic exposure control
ALARA	As low as reasonably achievable
Bq	Becquerel
C-Arm	Mobile fluoroscopic equipment
CBCT	Cone beam computed tomography or C-arm CT
CR	Computed radiography
CRIP	CR imaging plate
CT	Computed tomography
CTDI	Computed tomography dose index
CTV	Anatomo-clinical target volume
DCBE	Double contrast barium enema
DFV	Display field of view
DLP	Dose-length product
DR	Digital radiography
ECG	Electrocardiogram
EEG	Electroencephalogram
EMG	Electromyogram
ERCP	Endoscopic retrograde cholangio-pancreatography
FID	Focal spot-to-image receptor distance
FOV	Field of view
FSSD	Focal spot-to-skin distance
GTV	Gross tumour volume
Gy	Gray
HIS	Hospital Information System
HVL	Half-value layer
ICCM	Iodine-containing contrast medium

EQUIPMENT, EXAMINATIONS AND RADIATION PROTECTION

keV	kiloelectron-Volt
kV	kilovolt
mAs	Milliampere-second
mCi	milliCurie
MLC	MultiLeaf collimator
MRI	Magnetic resonance imaging
MU	Monitor unit
OAR	Organ at risk
PACS	Picture archiving and communication system
PET	Positron emission tomography
PICC-line	Peripherally inserted central catheter
PRV	Planning organ-at-risk volume
PTV	Planning target volume
RIS	Radiology Information System
RX	Radiography
Scan	Scintigraphy
SPECT	Single-photon emission computerized tomography
SUV	Standard uptake value
Sv	Sievert
TV	Target volume
US	Ultrasonography
WHMIS	Workplace Hazardous Materials Information System

POSITIONING

AL	Anatomical line
AML	Acanthio-meatal line
AP	Anterior-posterior
Dors. dec.	Dorsal decubitus
EAM	External auditory meatus
LAO	Left anterior oblique
LAPO	Left anterior-posterior oblique
LL	Left lateral external
LL Dec.	Left lateral decubitus
LM	Left lateral internal
LPAO	Left posterior-anterior oblique
LPO	Left posterior oblique
MPSP	Moving Patients Safety Principles
MSP	Midsagittal plane
PA	Posterior-anterior
RAO	Right anterior oblique
RAPO	Right anterior-posterior oblique
RL	Right lateral external
RL Dec.	Right lateral decubitus
RM	Right lateral internal
RPAO	Right posterior-anterior oblique
RPO	Right posterior oblique
WB	Whole body

PATHOLOGIES AND CLINICAL INFORMATION

AAA	Abdominal aortic aneurysm
APN	Acute pyelonephritis
ARDS	Acute respiratory distress syndrome
ARDS	Adult respiratory distress syndrome
ASHD	Atherosclerotic heart disease
ATB	Antibiotic
bid	Twice daily
BP	Blood pressure
BPH	Benign prostatic hypertrophy
bpm	Beats per minute
bx	Biopsy
COPD	Chronic obstructive pulmonary disease
CPR	Cardiopulmonary resuscitation
CSF	Cerebrospinal fluid
CVA	Cerebrovascular accident, stroke
DHS	Dynamic hip screw
DLMP	Date of last menstrual period
Dx	Diagnosis
eRPF	Effective renal plasma flow
Fx	Fracture
GFR	Glomerular filtration rate
HBP	High blood pressure
HIV	Human immunodeficiency virus
HR	Heart rate
HV	Hepatitis virus (A & E)
Hx	History, background

PATHOLOGIES AND CLINICAL INFORMATION

KPS	Karnofky performance scale
LBB	Left bundle-branch
LE	Lower extremity
LIF	Left iliac fossa
Lux	Luxation
MRSA	Methicillin-resistant Staphylococcus aureus
Neo	Neoplasia
NSTEMI	Non-ST elevation myocardial infarction
od	Once daily
ORIF	Open reduction and internal fixation
ORSA	Oxacillin-resistant Staphylococcus
P	Pain
PCAV	Possible child abuse victim
PE	Pulmonary embolism
Peri-op	During the operation
PLIF	Posterior lumbar interbody fusion
Post-op	After the operation
Pre-op	Before the operation
prn	As needed
PSA	Prostate specific antigen
R/O	Rule out
RA	Rheumatoid arthritis
RIF	Right iliac fossa
RR	Respiratory rate
RSP	Retrosternal pain
S/P	Status post
SAH	Subarachnoid hemorrhage

PATHOLOGIES AND CLINICAL INFORMATION

SARS	Severe acute respiratory syndrome
SDH	Subdural hemorrhage
SO ₂	Blood oxygen saturation
ST	Stress test
STAT	Immediately
STST	Submaximal treadmill stress test
Sx	Surgery
TB	Tuberculosis
TFN	Trochanter femoral nail
THR	Total hip replacement
TIA	Transient ischemic attack
TKR	Total knee replacement
TNM	T (primary tumour); N (metastatic lymphatic nodule); M (metastasis)
TP	Thrombophlebitis
TST	Tuberculin skin test
Tx	Treatment
UE	Upper extremity
w/r	With respect to

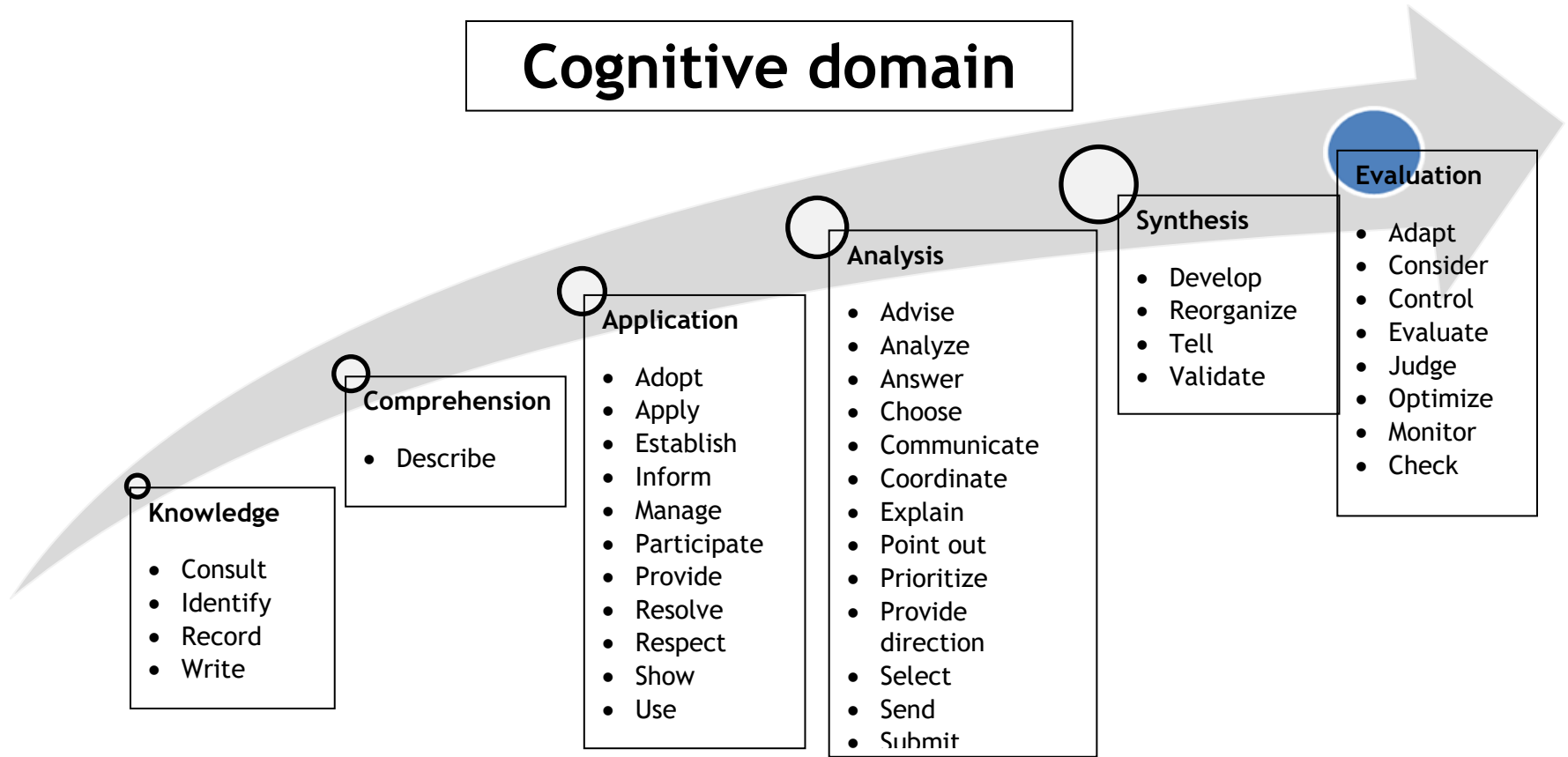
A FEW DEFINITIONS

Analysis	The separating of constituent elements or parts of a communication, in order to clarify the relative hierarchy of ideas and/or the relationship between the ideas expressed. These analyses are intended to clarify the communication, its organization, the means used to attain the desired goal and the basis on which it was developed and arranged. (Legendre, 2005, p. 1350)
Application	The use of abstract representations in special and concrete cases. Such representations may take the form of either general ideas, procedural rules or widely used methods, or principles, ideas and theories to be recalled and applied. (Legendre, 2005, p. 1350)
Competency attainment	According to CMA (2008), integration of knowledge, skills, attitudes and judgement in real clinical situations that require problem-solving, communication and critical thinking to address patient needs and conditions.
Competency:	According to the Quebec Ministère de l'Éducation, du Loisir et du Sport (2006), a competency is knowing how to act based on the mobilization and efficient use of a set of resources. (p. 4) According to Le Boterf (2008), being competent is being able to act successfully in a work situation (e.g., activity to perform, event to face, problem to solve, project to complete). It's conducting a relevant <i>professional practice</i> while mobilizing an <i>appropriate set of resources</i> (e.g., knowledge, abilities, behaviours, reasoning processes). (p. 21) According to Scallon (n.d.), to be called competent , an individual must have done something (e.g., production, process) on several occasions. He also defines competency as the ability to draw on a set of internal (knowledge, know-how, strategies, interpersonal skills) and external (documents, experts, internet, other students) resources to address a series of complex situations.
Comprehension	The most elementary level of understanding. This understanding or intellectual grasp allows the student to know what has been transmitted and to use the material or ideas that are communicated to him or her without necessarily establishing a link between this material and other material or grasping the full significance. (Legendre, 2005, p. 1350)
Entry-level competency	Competencies required for a technologist going into the profession on day one.
Evaluation	Making judgments about the value of the material and the methods used for a specific purpose. Qualitative or quantitative judgments that identify the extent to which the material and methods meet the criteria. (Legendre, 2005, p. 1350)
Knowledge acquisition	Knowledge supposes the recall of specific and general facts, methods and processes or the recall of a model, a structure or an order. With regard to the measurement of knowledge, the behaviour of recalling simply requires the individual bring up the material stored in memory. (Legendre, 2005, p. 1349)

A FEW DEFINITIONS

Prescription	A direction given to a professional by a physician, a dentist or another professional authorized by law, specifying the medications, treatments, examinations or other forms of care to be provided to a person or a group of persons, the circumstances in which they may be provided and the possible contraindications. A prescription may be individual or collective. (Professional Code: section 39.3)
Skills and attitudes	Technologists who demonstrate a good professional attitude are acting according to their skills for achieving all the elements necessary for competence (OTIMRO, 2010).
Synthesis	The combining of the constituent elements and parts into a single entity. This operation consists of combining and arranging the fragments, parts, elements, etc. in such a way as to form a plan or structure that was not previously clearly visible. (Legendre, 2005, p. 1350)
Taxonomy of the affective domain	Hierarchical set of objectives related to attitudes, interests, values, assessments, emotions, feelings and the ability to adjust. (Legendre, 2005, p. 1347)
Taxonomy of the cognitive domain (Bloom)	Learning model offering a hierarchical classification of levels of knowledge acquisition. These levels are organized from the simple restitution of facts to the complex manipulation of concepts that often engage the cognitive (superior) faculties. It can be summarized into six levels, each higher level encompassing the previous levels. According to Legendre (2005), it is a hierarchical set of objectives concerning both knowledge acquisition and the acquisition of the intellectual skills and abilities that lead to the use of such knowledge. (p. 1349)
Taxonomy of the psychomotor domain	Hierarchical set of objectives related to motor skills, object manipulation, muscle coordination and body movements. (Legendre, 2005, p. 1356)

APPENDIX 2: TAXONOMY



Affective domain**Competencies**

Ensure the patient's comfort and safety

Contribute, collaborate with other professionals

Keep an eye and an ear on patient

Preserve the patient's dignity, keep a clean and safe environment

Reassure the patient

Ensure patient consents

Introduce oneself to patient

Psychomotor domain**Competencies**

Administer

Act / React / Take action

Install

Calculate

Start

Dispose of objects, waste...

Perform / Carry out / Execute

Elute / Calibrate

Record

Store

Send / Ship / Receive

Install

Limit

Handle

Mark

Position

Collect / Withdraw

Take

Prepare work sites, material...

Prevent infections from spreading

Proceed

Treat

Transfer patients, objects...

BIBLIOGRAPHY

- Canadian Association of Medical Radiation Technologists. (2006). *Radiological Technology: Competency Profile*. Ottawa.
- Canadian Medical Association (2008). *Requirements for accreditation*. Ottawa: Canadian Medical Association Publication.
- Bloom, B. (1991). *Revised Bloom's Taxonomy*. Document available at: <http://nwlinc.com/~donclark/hrd/bloom.html>
- Office des professions du Québec. Document available at: <http://www.opq.gouv.qc.ca/lois-et-reglements/code-des-professions/>
- Le Boterf, G. (2008). *Repenser la compétence : Pour dépasser les idées reçues : 15 propositions*. Paris: Édition Eyrolles.
- Legendre, R. (2005). *Dictionnaire actuel de l'éducation. 3rd Edition*. Guérin éditeur: Montreal.
- Ministère de l'Éducation, du Loisir et du Sport (1998). *Technologie de radiodiagnostic*. Document available at: <http://www.mels.gouv.qc.ca/ens-sup/ens-coll/cahiers/program/142A0.asp>.
- Ministère de l'Éducation, du Loisir et du Sport. (2006). *Programme de formation de l'école québécoise, version approuvée*. Quebec City: Bibliothèque nationale du Québec.
- Ordre des technologues en imagerie médicale et en radio-oncologie du Québec (1). (2003). *Rapport d'analyse de la situation de travail*. Montreal: Publication de l'Ordre des technologues en imagerie médicale et en radio-oncologie du Québec.
- Ordre des technologues en imagerie médicale et en radio-oncologie du Québec (2). (2003). *Recueil des objectifs terminaux en radiodiagnostic*. Montreal: Publication de l'Ordre des technologues en imagerie médicale et en radio-oncologie du Québec.
- Ordre des technologues en imagerie médicale et en radio-oncologie du Québec (3). (2006). *Avis de radioprotection : dosimétrie individuelle pour thermoluminescence*. Montreal: Publication de l'Ordre des technologues en imagerie médicale et en radio-oncologie du Québec.
- Ordre des technologues en imagerie médicale et en radio-oncologie du Québec (4). (2010). *Normes de pratique générales et spécifiques*. Montreal: Publication de l'Ordre des technologues en imagerie médicale et en radio-oncologie du Québec.
- Ordre des technologues en imagerie médicale et en radio-oncologie du Québec (5). (2010). *Code de déontologie*. Montreal: Publication de l'Ordre des technologues en imagerie médicale et en radio-oncologie du Québec.
- Scallon, G. (n.d.). *Évaluer pour faire apprendre dans une approche par compétences*. Laval University

