University of North Carolina Hospitals

Medical Dosimetry Program

Student Handbook

2018-2019

Approved 5-20-2018

Reviewed and Revised May 2018 for the Academic Year 2018-2019

Table of Contents

Program Director Contact Information

Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD

Medical Dosimetry Program Director

University of North Carolina Hospitals

Assistant Professor

Department of Radiation Oncology

University of North Carolina at Chapel Hill

101 Manning Drive

Chapel Hill, NC 27514-7512

Office: (984) 974-8427

Fax: (919) 966-7681

E-mail: robert_adams@med.unc.edu

2018-2019 Program Development Committee

Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology

Elaine Zeman, PhD
Instructor, Associate Professor
UNC Department of Radiation Oncology

Shiva Das, PhD
Head of Medical Physics
UNC Department of Radiation Oncology

Patty Saponaro, MBA
Administrative Director
UNC Department of Radiation Oncology

Jackie Williamson, BS, CMD
Clinical Educator
UNC Department of Radiation Oncology

Lesley Hoyle, BS, CMD
Supervisor, Dosimetry
UNC Department of Radiation Oncology

Amy Lindsey, MA, CMD, RT(T)
Medical Dosimetrist
Rex Radiation Oncology, Raleigh, NC

Two incoming medical dosimetry students 2018-2019

Introduction

The following general information regarding policies, procedures, regulations, and schedules has been prepared for the student entering the UNC Hospitals Medical Dosimetry Program. The student should familiarize him/herself with these policies, procedures, etc., ask questions for better understanding, and abide by them to the best of his/her ability.

Students of all backgrounds are equally welcome to the program irrespective of race, sex, or national origin. Members of the program faculty are happy to discuss career opportunities and related matters in medical dosimetry with all interested students.

Mission

The UNC Hospitals Medical Dosimetry Educational Program will prepare competent, educated, and professional entry-level medical dosimetrists who will participate in scholarly activity and enhance overall patient care. (JRCERT Standards 1.10, 3.1).

Goals & Student Learning Outcomes (JRCERT Standard 1.10)

Goal 1: Students will be clinically competent.

A) Student Learning Outcome: Students will demonstrate acquisition of correct dosimetry treatment planning skills.
B) Student Learning Outcome: Students will evidence competency in treatment.

Goal 2: Students will demonstrate effective communication skills.

A) Student Learning Outcome: Students will effectively communicate with patients, medical dosimetrists, faculty, and staff.
B) Student Learning Outcome: Students will write at a proficient level by graduation.

Goal 3: Students will develop critical thinking skills.

A) Student Learning Outcome: Students apply didactic concepts and information into the clinical setting.
B) Student Learning Outcome: Students will conceptualize current patient safety radiation therapy Lean A3 engineering principles.

Goal 4: Students will grow and develop professionally.

A) Student Learning Outcome: Students will demonstrate professional behaviors.
B) Student Learning Outcome: Students will participate in continuing education.

Program Description

The medical dosimetrist is a vital and essential member of the radiation oncology team. The UNC Hospitals Medical Dosimetry Program is located in the UNC Department of Radiation Oncology in Chapel Hill, NC. The UNC Department of Radiation Oncology was formed in 1987 from the UNC Division of Radiation Therapy. The UNC Division of Radiation Therapy began in 1969 with the purchase of a Cobalt-60 unit.

The program course material and practicum covers radiation physics, radiation protection, dose calculations, tumor localization, external beam treatment planning, brachytherapy, quality assurance, medical imaging/anatomy, clinical radiation oncology, and radiobiology. Clinical practicum includes external beam treatment planning, brachytherapy treatment, preparation, and planning, chart reviews and dose calculations, record and verify system data entry, treatment machine quality assurance, CyberKnife, TomoTherapy, and IMRT planning and treatment. Special project assignments, conference attendance and presentation, and journal article reviews are also part of the curriculum.

Program Purpose

The purpose of the UNC Hospitals Medical Dosimetry Program is to fulfill its mission and goals through the completion of stated objectives. The program provides superior quality higher education with flexibility to accommodate expanding technological growth in radiation oncology and medical dosimetry created knowledge and clinical practice. The program maintains relationships with other educational programs for support and collaboration to improve medical dosimetry education.

The student has the responsibility to make the most of available educational experiences, and once accepted, is obligated to abide by the policies and procedures of the UNC Hospitals Medical Dosimetry Program.

Non-Discrimination

The program, as with UNC Hospitals policy (http://www.unchealthcare.org/site/humanresources/careers/why/code/) , does not discriminate in student recruitment or admissions practices on the grounds of race, color, sex, religion, gender, age, disability, marital status, national origin, or any other protected class. If the student has a question/concern about discrimination, he/she may contact the UNC Department of Radiation Oncology Administrative Director at (984) 974-5200 (JRCERT Standard 1.12).

Advising

Being housed within a Carnegie Level 1 Research Institution allows the UNC Hospitals Medical Dosimetry Program to offer the student excellent supportive academic, behavioral, and clinical advisement.

The UNC Hospitals Medical Dosimetry Program Director and didactic and clinical instructors are available for recruitment and pre-admissions advising as necessary. The admissions procedure for the program includes an extensive advising session. The enrolled student has an orientation advising session at the beginning of each semester.

The program director and didactic and clinical instructors are also available for individual academic, behavioral, and/or clinical advisement as needed. Each didactic instructor provides mid-semester feedback to the medical dosimetry student. Additionally, the program director meets both mid-semester and post-semester with each UNC Hospitals medical dosimetry student to discuss his/her progress through the curriculum.

Because the medical dosimetry program is housed within the UNC Department of Radiation Oncology, the program director/instructors orally communicate with each student almost daily. This type of continuous communication allows for both informal and formal feedback between the student and the program director, thus allowing a continuous type of advising between the program director and the student on academic, behavioral, and/or clinical issues.

Additionally, each UNC Hospitals medical dosimetry student has access to the UNC-Chapel Hill Libraries (5, including a dedicated Health Sciences Library) to access/check out journals/books, and use the learning resources. The UNC Hospitals student also has access to the UNC Libraries via departmental Internet. Moreover, for a fee of ~$120/year, the student has access to the student recreational center.

Finally, academic, behavioral, and clinical advisement is also offered by UNC School of Medicine faculty. As an external advisement measure, the UNC Hospitals Nuclear Medicine Program Director is available as a student advisor for any academic, behavioral, or clinical issues (JRCERT Standard 3.7).

JRCERT Program Accreditation

The program is recognized by the Joint Review Committee on Education in Radiologic Technology (JRCERT). A copy of the Standards for an Accredited Educational Program in Medical Dosimetry is available online and from the program director. Any questions about the program may be forwarded to either the program director or the JRCERT (JRCERT Standard 1.7). The JRCERT contact information is:

JRCERT
20 N. Wacker Drive
Suite 2850
Chicago, IL 60606-2901
Phone: (312) 704-5300
E-mail: mail@jrcert.org

In addition to being in this student handbook, the UNC Hospitals Medical Dosimetry Program Effectiveness Data is also available via the JRCERT's Web site, jrcert.org (JRCERT Standard 5.2).

The medical dosimetry program effectiveness data is also on the UNC Hospitals Medical Dosimetry Program Web page (JRCERT Standard 5.3).

UNC Hospitals Medical Dosimetry Program Effectiveness Data

Outcome	Measurement Tool	Benchmark	Timeframe	Responsible Party	Results
Attrition	Program completion rate	50%	Annual	Program Director (reported annually to the Development Committee)	2017: 50% 2016: 0% 2015: 0% 2014: 0% 2013: 0% 2012: 0% 2011: 0% 2010: 0%
Pass Rate	Credentialing examination pass rate	75%	5-year average pass rate (at 1st attempt within 12 months of graduation)	Program Director (reported annually to the Development Committee)	2017: 100% 2016: 100% 2015: 100% 2014: 100% 2013: 100% 2012: 100% 2011: 100% 2010: 100%
Employment	Job placement rate	75%	5-year average pass rate (at 1st attempt within 12 months of graduation)	Program Director (reported annually to the Development Committee)	2017: 100% 2016: 100% 2015: 100% 2014: 100% 2013: 100% 2012: 100% 2011: 100% 2010: 100%
Graduate Satisfaction	Graduate survey	At least a 4 on a 5 point scale	Annual	Program Director (reported annually to the Development Committee)	2017: 4.9/5 2016: 4.6/5 2015: 4.5/5 2014: 4.4/5 2013: 4.4/5 2012: 4.4/5 2011: 4.3/5 2010: 4.2/5
Employer satisfaction	Employer survey	At least a 4 on a 5 point scale	Annual	Program Director (reported annually to the Dev Committee	2017: 4.9/5 2016: 4.9/5 2015: 4.9/5 2014: 4.8/5 2013: 4.8/5 2012: 4.7/5

The Sponsoring Institution

UNC Hospitals sponsors the medical dosimetry program. All program functions, including administrative structure (organizational structure and administrative support, as well as didactic and clinical faculty, faculty continuing medical education, and clerical support services are coordinated and administered by UNC Hospitals and UNC School of Medicine faculty and staff (JRCERT Standards 2.1, 2.2, 2.3, 2.4). Moreover, the education program has a dedicated didactic classroom, dedicated student work areas, and dedicated student clinical work stations. The education program reviews and maintains student learning resources and student services as would be expected at a Carnegie Level 1 Research Institution (JRCERT Standards 2.6, 2.7, 2.8, 2.9). Finally, the UNC Hospitals clinical medical dosimetry setting is recognized by the JRCERT. The education program has no external clinical sites (JRCERT Standard 2.5).

The UNC Department of Radiation Oncology has the following student groups/education programs: 1) UNC Hospitals radiation therapy students, 2) UNC Hospitals medical dosimetry students, 3) UNC Hospitals medical physics residents, and 4) UNC Hospitals radiation oncology medical residents and the following visiting students: 1) UNC radiologic science students, 2) UNC nursing students, and 3) UNC medical students. The UNC Department of Radiation Oncology has a tripartite mission of clinical care, research, and education. This mission correlates with the UNC School of Medicine and the greater UNC Hospitals. The University of North Carolina, UNC Hospitals, and its programs are all physically located on the contiguous UNC-Chapel Hill/UNC Hospitals campus.

Professional liability insurance coverage is taken care of by a group policy through UNC Hospitals.

Agreement to Adhere to the Program's Policies and Procedures

The student indicates acceptance of these policies and procedures by enrollment in the UNC Hospitals Medical Dosimetry Program. The program reserves the right to change these policies and procedures when in the best interest of the program. Upon implementation, the student will receive written notification of any changes. It should be noted that during orientation there is a review of the student handbook. Each student signs and dates a form that states that he/she understands all policies and procedures within the UNC Hospitals Medical Dosimetry Program student handbook.

Policies Governing Student Continuation and Promotion

The student is responsible for observing the policies and procedures of the UNC Hospitals Medical Dosimetry Program as they are announced in this document. The program director will assist the student with the details of his/her program and/or academic problems. This assistance does not relieve the student of his/her individual responsibility for meeting the requirements and observing the regulations of UNC Hospitals, the UNC Department of Radiation Oncology, and the UNC Hospitals Medical Dosimetry Program.

Corrective Action and Grievance Procedure: Student Right to Appeal (Due Process)

The medical dosimetry program director must address issues in which the student fails to follow dosimetry program curriculum guidelines or policies:

The issue will be adjudicated in the following manner:

A) The program director will determine the necessary course of action and present it to the student.
B) If formal discussion with the program director does not resolve the violation, misinterpretation, or inequitable application of any existing policy, procedure, or regulation, or other action issue to the student's satisfaction, the student has the right to submit a written appeal to the UNC Hospitals Medical Dosimetry Program Development Committee within 10 working days following the initial date of the issue. The appeal will then be directed to the UNC Department of Radiation Oncology Administrative Director. If the issue is not resolved to the student's satisfaction, the student has 10 working days to submit a second written appeal to the program development committee. The appeal will then be directed to the UNC Department of Radiation Oncology Associate Chair. If the issue is still not resolved to the student's satisfaction, the student has 10 working days to submit a third written appeal to the development committee. The final appeal will then be directed to a mediation committee, whose members are outside the UNC Department of Radiation Oncology. This committee consists of the following members: the UNC Nuclear Medicine Program Director, the UNC Nuclear Medicine Chair, and a UNC Nuclear Medicine student. This is the final appeal process for the student (JRCERT Standard 1.6).

The program also assesses current student and alumni evaluations for the general overall structure and function of the education program via specific questions through its semester course evaluations and graduate surveys. The program director, faculty, and staff are always available for comments/suggestions about any component of the education program that needs improvement. If for any reason a student feels he/she is not being heard, he/she should speak directly with the program director to make sure the request/suggestion/complaints has been communicated properly.

If the student wishes to contact the JRCERT regarding a situation, he/she may do so with the aforementioned information.

Workplace Hazards, Harassment, Communicable Diseases, and Substance Abuse

In the event that the student is concerned with workplace hazards, harassment, communicable diseases, or substance abuse, he/she should contact the program director of faculty immediately. The program director will work with the facility to ensure the safety of the student (JRCERT Standard 4.6).

Grades

To be eligible for a certificate in medical dosimetry, the student must satisfactorily pass all courses in the UNC Hospitals Medical Dosimetry Program curriculum. If the student's academic and/or clinical performance is considered unsatisfactory, the student will be placed on formal probation. In order to remove the probationary status, the student must make at least 80% on subsequent assignments during the next semester and complete any remedial work/examinations as required by the didactic instructor and approved by the Program Development Committee. Should the probationary status go unremoved, the student will be dismissed from the program. To satisfactorily pass a course means that the student earns a grade of at least a C. To satisfactorily pass a course in which the student makes a C-, the student must complete any remedial work/examinations as required by the didactic instructor and approved by the Program Development Committee.

Any student making a grade of D in any one course will automatically be dismissed from the program.

If the student is dissatisfied with any didactic and/or clinical grade during the course of the year, he/she has the right to appeal. Please see the Corrective Action and Grievance Procedure: Student Right to Appeal (Due Process) section in this document.

Code of Conduct

Expulsion or suspension, or lesser sanctions, may result from the commission of any of the following offenses:

> Academic cheating, including (but not limited to) unauthorized copying, collaboration, or use of notes/books on examinations, and plagiarism (defined as the intentional representation of another person's words, thoughts, or ideas as one's own).

For academic cheating, suspension is the normal sanction for the initial offense, unless the Program Development Committee determines that unusual mitigating circumstances justify a lesser sentence.

The furnishing of false information, with the intent to deceive, to members of the UNC Hospitals community who are acting in the exercise of their official duties, forgery, falsification, and/or fraudulent misuse of UNC Hospitals documents, records, or identification cards will result in expulsion from the program.

It is noted that a sanction against a student may also result in the student being dismissed from the program. For example, if a grade of F is given in a course in which the student has admitted cheating, he/she will be dismissed from the program.

Every student has the right to appeal any infraction of the Code of Conduct. Please see the Corrective Action and Grievance Procedure: Student Right to Appeal (Due Process) section in this document.

Dismissal from the Program

In addition to academic ineligibility to complete the program, the student may be dismissed for inappropriate professional attitudes and/or actions, as described in the American Association of Medical Dosimetrists (AAMD) Code of Ethics, and the practice standards established by the profession. These standards are important professional standards for the student preparing to deliver a high standard of healthcare delivery and service.

A student may be judged unacceptable for continuation in the UNC Hospitals Medical Dosimetry Program when he/she has displayed a lack of professionalism with respect to other students, patients, faculty, and/or staff.

The UNC Hospitals Medical Dosimetry Program reserves the right to dismiss a student from the program when the student does not, in its judgment, demonstrate sufficient promise to justify continuation of study in the UNC Hospitals Medical Dosimetry Program.

If the student is dismissed from the program, he/she has the right to appeal, as stated in this document.

Readmission

A student who withdraws from the program must reapply and go through the admissions process again. No refunds are made after orientation is complete.

Use of Illegal Drugs

Students, faculty, and staff of UNC Hospitals are responsible, as citizens, for knowing about and complying with the provisions of North Carolina law that make it a crime to possess, sell, deliver, or manufacture those drugs designated collectively as “controlled substances” in Article 5 of Chapter 90 of the North Carolina General Statutes. Any member of the Hospitals community who violates that law is subject both to prosecution and punishment by civil authorities and to disciplinary proceedings by the UNC Department of Radiation Oncology. Disciplinary proceedings against a student, faculty member, or staff member will be initiated when the alleged conduct is deemed to affect the interests of UNC Hospitals.

Before entry into the UNC Hospitals Medical Dosimetry Education Program, the accepted student will have to pass an official drug test.

Health Program

Students in the UNC Hospitals Medical Dosimetry Program are under the healthcare program of UNC Hospitals. It is mandatory that the student carry a hospitalization insurance policy to cover any necessary operations or special services that may be required during his/her education.

Holidays

The student will not have class or clinical on hospital holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Days before and after Thanksgiving, Christmas Eve, Christmas Day, and day after Christmas. The student must be present on all other holidays unless preapproved by the program director.

Sick Time

The student must contact the program director/didactic/clinical instructor in all cases if sick by 8:00 a.m. that morning. Any time missed by the student due to calling in sick must be made up. If the student misses class time, he/she is responsible to contact the instructor and make up missed information – notes, quizzes, or exams. If the student misses clinical rotations, he/she must make up time during scheduled vacations or come early/stay late. The student may not exceed more than 40 hours/week or more than 10 hours in any day. If the student exceeds these time limits, he/she must do so voluntarily.

Due to the nature of the program's curriculum, class attendance and timeliness are mandatory, with the exception of student/family illness or attendance of professional meetings/seminars. These exceptions will constitute an excused absence and the student is to make up any missed didactic work. Class absences are excused only by the program director or didactic instructor; any absence regarding professional meetings/seminars must be approved in advance.

Excessive tardiness is subject to corrective discipline, in the form of probation and/or dismissal. Excessive tardiness is defined as more than three instances of lateness in a semester. After four instances, the student will be placed on formal probation. Any five instances in a semester will result in dismissal from the program.

In order to be fair and equitable to each student and the program, it is the policy of the program that the student cannot bank time before an absence. The student can, however, make up time after the absence.

Inclement Weather Policy

If bad weather (snow, ice, flooding, tornado, earthquake, etc.) occurs on a clinical day, the student is responsible for finding out if the local university is closed. If it is closed due to hazardous road conditions, the student is excused from going to class/clinical, even though the Radiation Oncology department may be open. The student must write "Inclement Weather" on his/her time sheet, and this absence will be verified by the clinical instructor. If the local university is open, but the student cannot get to UNC Hospitals, then he/she must make up the day.

Note: All unexcused "Inclement Weather" days must be made up.

Dress Code

All clothing and jewelry must be consistent with professional/business dress standards applicable to the work responsibilities involved and must be appropriate for reasonably anticipated public contact. The student should wear a white mid-length lab coat at all times. The student's clothes should be neatly pressed for a professional appearance. Males should also wear a tie. Dress shoes should also be worn; however, no open-toed dress shoes are allowed.

The student must wear his/her UNC Hospitals name badge each day. The identification badge must be worn so that the picture, name, and department are easily visible at all times.

Hair, including beards and mustaches, is to be clean, neatly groomed, and kept in such a way as not to interfere with student duties or safety. Hair that is longer than the collar on males, or longer than the shoulder on females, is to be pulled back and fastened to prevent contamination.

Makeup, perfume, and cologne are to be moderately applied

Fingernails are to be clean, trimmed, and extend no further than ¼'' beyond the fingertips. Clear or conservative light-colored nail polish may be worn.

No visible tattoos are allowed. Piercings are limited to ears only (one set of earrings).

Disability, Illness, Pregnancy

The program director will determine if a student may continue the program should illness or disability arise. The decision will be made on an individual basis, taken into account the nature and degree of the disability, as well as a physician's recommendation that the student may continue the program.

If a student becomes pregnant while in the program, the pregnancy policy within this handbook will be followed.

The student must make up all missed class and clinic time. If the student is unable to complete assigned time commitments by the end of the program he/she will not graduate until he/she has successfully completed class and clinical rotations.

Student Clinical Hours

8:00 a.m. – 4:30 p.m.

Hours may possibly vary depending upon the clinical rotation requirements. The student sometimes may need to remain in the clinic beyond the normal hours in order to complete a project related to his/her learning. On rare occasions, the student may need to work on a Saturday or Sunday to complete a quality assurance procedure. However, these student clinical clock hours must not exceed 25% of the total clock hours (10 hours during the weekend) (JRCERT Standard 1.3).

Clinic Site	Phone Number	Clinical Instructors
UNC Hospitals NC Cancer Hospital Dept. of Radiation Oncology 101 Manning Drive Chapel Hill, NC 27514-7512	(919) 445-5547	Jackie Williamson, CMD Heather Baliker, CMD Raina Erwin, CMD Matthew Hawkins, CMD David Chang, CMD

Emergency/Safety Orientation

During the initial program orientation, the student will participate in an emergency procedures/safety orientation specific to UNC Hospitals. These health and safety issues are completed before the student is allowed in the UNC Hospitals clinical area. The policies and procedures include, but are not limited to, the following (JRCERT Standard 4.7):

Hazards: Fire, electrical/chemical emergencies

Emergency Preparedness

Medical Emergencies

HIPAA

Standard Precautions

Attendance

The student must report to his/her assigned class or clinical rotation for the duration of the hours specified by the schedule, unless preapproved by the program director for absence or tardiness. If the student misses 5 days throughout the program, his/her clinical grade will be lowered one letter grade. If the student misses 6 or more days during the year, the student can be removed from the program.

The student is expected to report to the class/clinical area at the designated time. Tardiness is not considered responsible, professional behavior. Three late arrivals, each in excess of 10 minutes, will be considered the equivalent of one absence for grade determination. It is the student's responsibility to call the program director/clinical instructor prior to the beginning of the class/clinical time period if he/she is going to be late. Failure to do this will result in 2 points being deducted from the final clinical grade for each infraction.

Vacation

The student receives 5 days of vacation. He/she is allowed 1 personal day (i.e. for a wedding/funeral) and 2 interview days while in the program. The interview days require documentation and may only be taken during the spring or summer semesters.

The student is given release time to attend professional meetings/seminars. The student is responsible for his/her travel, hotel, and conference fee.

Health Insurance – Emergency Situation

If the student has an emergency, he/she is to go to the local hospital emergency room or urgent care clinic.

Radiation Monitoring

The student must wear a personnel monitoring device at all times in the clinic. Exposure reports will be available for review once processed. If a dose reading exceeds normal limits (≥0.125 rem or ≥1.25 mSv per quarter) the student will be contacted by the UNC Radiation Safety Officer or program personnel. In the event an accidental exposure occurs, the student must notify the program director regarding the incident. The program director will work with the Radiation Safety Officer and make a plan of action for the event. If the badge is lost, damaged, or the student has any other concerns, he/she should contact the program director (JRCERT Standard 4.1, 4.3).

If a student feels that he/she has received a high radiation dose exposure (exceeding normal limits of ≥0.125 rem or ≥1.25 mSv per quarter) for any reason, the student should immediately contact the program director. The student should not wait. An emergency reading will be done by UNC Radiation Safety.

UNC Hospitals badges are read quarterly. When the quarterly reports come to the UNC Department of Radiation Oncology, they are posted in the M and B level break rooms. It is each student's responsibility to look at an initial the report.

UNC Hospitals has a Radiation Safety department on site. If anyone has a high radiation reading, the UNC Radiation Safety department will notify the program director and student in writing and in person.

Direct Supervision Policy

All procedures performed by a student while on a clinical rotation must be directly supervised by a qualified practitioner. This individual will receive the procedure in relation to the student's achievement, evaluate the condition of the patient in relation to the student's knowledge, be present during the procedure, and review and approve the procedure. All clinical work performed by a student must be checked prior to clinical implementation. Any time a student is having direct contact with a patient, facility personnel must be present (JRCERT Standard 4.5).

Classroom Behavior/Code of Conduct

The classroom is a safe environment for the student. The focus will be on learning. Causing disruptions, harassment of other students, foul language, disrespect for others, or entertaining at someone else's expense will not be tolerated.

UNC Hospitals Medical Dosimetry Program Pregnancy Policy

The UNC Hospitals Medical Dosimetry faculty recognize the basic premise of providing the pregnant student with the information to make an informed decision based on her individual needs and preferences. Thus, all UNC Hospitals medical dosimetry students are requested to read the following documents, contained in this policy.

1. NCRP Report #116, 1993, Section 10 "Protection of the Embryo-Fetus"
2. US Nuclear Regulatory Commission Regulatory Guide 8.13, Revision 3 December 1999, "Instruction Concerning Prenatal Radiation Exposure"

Further information on the fetal effects of radiation may be found in Bushong's radiographic physics book on pages 543-548 and pages 559-565 (Bushong, SC (2004)). Radiologic science for technologists: Physics, biology, & protection, 8th ed. St. Louis, MO: Elsevier Science/Mosby, Inc.)

Finally, UNC Hospitals Medical Dosimetry faculty believe it is the responsibility of the pregnant student to advise her program director and clinical instructor voluntarily and in writing of her pregnancy and the estimated date of the baby's birth (delivery). Formal, voluntary notification (declaration of pregnancy) is the only means by which the clinical facility and the UNC Hospitals Medical Dosimetry Program can ensure that the dose to the embryo-fetus is limited during the pregnancy (not to exceed 5 mSv (500 mrem)). In the absence of the voluntary, written disclosure, the student cannot be considered pregnant.

Therefore, at the beginning of the program, each UNC Hospitals Medical Dosimetry female student will read the documents, have her questions answered to her satisfaction, and choose to proceed with her medical dosimetry education as indicated herein.

The voluntary, written disclosure of pregnancy and her decision toward the UNC Hospitals Medical Dosimetry Program will be kept in the student's folder, maintained by the program director. Release of such information may occur only upon the written permission of the student.

Declaration

I fully understand the contents of these documents, have had my questions answered to my satisfaction, and choose to proceed with my medical dosimetry education as indicated below.

_____ I am fully aware of the UNC Hospitals Medical Dosimetry Program pregnancy policy and choose to continue my didactic and clinical education without modification or interruption. If I am currently pregnant or become pregnant while in the medical dosimetry program, I may notify my program director or clinical instructor voluntarily and in writing with one of the options below if I want to declare my pregnancy.

_____ I am pregnant and choose to continue my didactic and clinical education without modification or interruption. I accept full responsibility for my own actions and the health of my baby. Furthermore, I absolve, discharge, release, and hold harmless my clinical site and its staff, and the Board of Trustees of UNC Healthcare together with its officers and employees (the medical dosimetry program and its faculty) for any legal liability, claims, damages, or complications that may occur during fetal growth, birth, and postnatal development of my baby.

_____ I am pregnant and choose to continue my didactic and clinical education with some modification of my clinical assignment. I will not participate in brachytherapy or CyberKnife procedures. A grade of incomplete will be given until I have completed all clinical education missed during my pregnancy. The completion of the incomplete may delay my sitting for the MDCB exam.

_____ I am pregnant and choose to take a leave of absence from clinical assignments during my pregnancy. A grade of incomplete will be given until I have completed all clinical education missed during my pregnancy. The completion of the incomplete may delay my sitting for the MDCB exam.

_____ I am pregnant and choose to take a leave of absence from the UNC Hospitals Medical Dosimetry Program. If I notify the program director of my desire to return, I will be offered a position in the next class, the following year.

_____ I wish to withdraw my previous declaration of pregnancy.

I agree to comply with the above-stated policy with my decision as indicated above.

____ _______________________

Student signature Date

____ _______________________

Program director signature Date

Appendix B

Prenatal Radiation Exposure, Regulatory Guide 8.13

A. Introduction

The Code of Federal Regulations in 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," in Section 19.12, "Instructions to Workers," requires instruction in "the health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed." The instructions must be "commensurate with potential radiological health protection problems present in the workplace."

The Nuclear Regulatory Commission's (NRC's) regulations on radiation protection are specified in 10 CFR Part 20, "Standards for Protection Against Radiation"; and 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to "ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv)." Section 20.1208 also requires licensees to "make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman." A declared pregnant woman is defined in 10 CFR 20.1003 as a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

This regulatory guide is intended to provide information to pregnant women, and other personnel, to help them make decisions regarding radiation exposure during pregnancy. This Regulatory Guide 8.13 supplements Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure" (Ref 1), which contains a broad discussion of the risks from exposure to ionizing radiation.

Other sections of the NRC's regulations also specify requirements for monitoring external and internal occupational dose to a declared pregnant woman. In 10 CFR 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose," licensees are required to monitor the occupational dose to a declared pregnant woman, using an individual monitoring device, if it is likely that the declared pregnant woman will receive, from external sources, a deep dose equivalent in excess of 0.1 rem (1 mSv). According to Paragraph (e) of 10 CFR 20.2106, "Records of Individual Monitoring Results," the licensee must maintain records of dose to an embryo/fetus if monitoring was required, and the records of dose to the embryo/fetus must be kept with the records of dose to the declared pregnant woman. The declaration of pregnancy must be kept on file, but may be maintained separately from the dose records. The licensee must retain the required form or record until the Commission terminates each pertinent license requiring the record.

The information collections in this regulatory guide are covered by the requirements of 10 CFR Parts 19 or 20, which were approved by the Office of Management and Budget, approval numbers 3150-0044 and 3150-0014, respectively. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

B. Discussion

As discussed in Regulatory Guide 8.29 (Ref. 1), exposure to any level of radiation is assumed to carry with it a certain amount of risk. In the absence of scientific certainty regarding the relationship between low dose exposure and health effects, and as a conservative assumption for radiation protection purposes, the scientific community generally assumes that any exposure to ionizing radiation may cause undesirable biological effects and that the likelihood of these effects increases as the dose increases. At the occupational dose limit for the whole body of 5 rem (50 mSv) per year, the risk is believed to be very low.

The magnitude of risk of childhood cancer following in utero exposure is uncertain in that both negative and positive studies have been reported. The data from these studies "are consistent with a lifetime cancer risk resulting from exposure during gestation which is two to three times that for the adult" (NCRP Report No. 116, Ref. 2). The NRC has reviewed the available scientific literature and has concluded that the 0.5 rem (5 mSv) limit specific in 10 CFR 20.1208 provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers associated with radiation exposure during pregnancy.

In order for a pregnant worker to take advantage of the lower exposure limit and dose monitoring provisions specified in 10 CFR Part 20, the woman must declare her pregnancy in writing to the licensee. A form letter for declaring pregnancy is provided in this guide or the licensee may use its own form letter for declaring pregnancy. A separate written declaration should be submitted for each pregnancy.

C. Regulatory Position

1. Who Should Receive Instruction

Female workers who require training under 10 CFR 19.12 should be provided with the information contained in this guide. In addition to the information contained in Regulatory Guide 8.29 (Ref. 1), this information may be included as part of the training required under 10 CFR 19.12.

2. Providing Instruction

The occupational worker may be given a copy of this guide with its Appendix, an explanation of the contents of the guide, and an opportunity to ask questions and request additional information. The information in this guide and Appendix should also be provided to any worker or supervisor who may be affected by a declaration of pregnancy or who may have to take some action in response to such a declaration.

Classroom instruction may supplement the written information. If the licensee provides classroom instruction, the instructor should have some knowledge of the biological effects of radiation to be able to answer questions that may go beyond the information provided in this guide. Videotaped presentations may be used for classroom instruction. Regardless of whether the licensee provides classroom training, the licensee should give workers the opportunity to ask questions about information contained in this Regulatory Guide 8.13. The licensee may take credit for instruction that the worker has received within the past year at other licensed facilities or in other courses or training.

3. Licensee’s Policy on Declared Pregnant Women

The instruction provided should describe the licensee’s specific policy on declared pregnant women, including how those policies may affect a woman’s work situation. In particular, the instruction should include a description of the licensee’s policies, if any, that may affect the declared pregnant woman’s work situation after she has filed a written declaration of pregnancy consistent with 10 CFR 20.1208.

The instruction should also identify who to contact for additional information as well as identify who should receive the written declaration of pregnancy. The recipient of the woman’s declaration may be identified by name (e.g., John Smith), position (e.g., immediate supervisor, the radiation safety officer), or department (e.g., the personnel department).

4. Duration of Lower Dose Limits for the Embryo/Fetus

The lower dose limit for the embryo/fetus should remain in effect until the woman withdraws the declaration in writing or the woman is no longer pregnant. If a declaration of pregnancy is withdrawn, the dose limit for the embryo/fetus would apply only to the time for the estimated date of conception until the time the declaration is withdrawn. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

5. Substantial Variations Above a Uniform Monthly Dose Rate

According to 10 CFR 20.1208(b), “The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section,” that is, 0.5 rem (5 mSv) to the embryo/fetus. The National Council on Radiation Protection and Measurements (NCRP) recommends a monthly equivalent dose limit of 0.05 rem (0.5 mSv) to the embryo/fetus once the pregnancy is known (Ref. 2). In view of the NCRP recommendation, any monthly dose of less than 0.1 rem (1 mSv) may be considered as not a substantial variation above a uniform monthly dose rate and as such will not require licensee justification. However, a monthly dose greater than 0.1 rem (1 mSv) should be justified by the licensee.

D. Implementation

The purpose of this section is to provide information to licensees and applicants regarding the NRC's staff's plans for using this regulatory guide.

Unless a licensee or an applicant proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods described in this guide will be used by the NRC staff in the evaluation of instructions to workers on the radiation exposure of pregnant women.

Appendix B

Questions and Answers Concerning Prenatal Radiation Exposure

1. Why am I receiving this information?

The NRC's regulations (in 10 CFR 19.12, "Instructions to Workers") require that licensees instruct individuals working with licensed radioactive materials in radiation protection as appropriate for the situation. The instruction below describes information that occupational workers and their supervisors should know about the radiation exposure of the embryo/fetus of pregnant women.

The regulations allow a pregnant woman to decide whether she wants to formally declare her pregnancy to take advantage of lower dose limits for the embryo/fetus. This instruction provides information to help women make an informed decision to declare a pregnancy.

2. If I become pregnant, am I required to declare my pregnancy?

No. The choice whether to declare your pregnancy is completely voluntary. If you choose to declare your pregnancy, you must do so in writing and a lower radiation dose limit will apply to your embryo/fetus. If you choose not to declare your pregnancy, you and your embryo/fetus will continue to be subject to the same radiation dose limits that apply to other occupational workers.

3. If I declare my pregnancy in writing, what happens?

If you choose to declare your pregnancy in writing, the licensee must take measures to limit the dose to your embryo/fetus to 0.5 rem (5 mSv) during the entire pregnancy. This is one-tenth of the dose that an occupational worker may receive in a year. If you have already received a dose exceeding 0.5 rem (5 mSv) in the period between conception and the declaration of your pregnancy, an additional dose of 0.05 rem (0.5 mSv) is allowed during the remainder of the pregnancy. In addition, 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to make efforts to avoid substantial variation above a uniform monthly dose rate so that all the 0.5 rem (5 mSv) allowed dose does not occur in a short period during the pregnancy.

This may mean that, if you declare your pregnancy, the licensee may not permit you to do some of your normal job functions if those functions would have allowed you to receive more than 0.5 rem, and you may not be able to have some emergency response responsibilities.

4. Why do the regulations have a lower dose limit for the embryo/fetus of a declared pregnant woman than for a pregnant worker who has not declared?

A lower dose limit for the embryo/fetus of a declared pregnant woman is based on a consideration of greater sensitivity to radiation of the embryo/fetus and the involuntary nature of the exposure. Several scientific advisory groups have recommended (Refs. 1 and 2) that the dose to the embryo/fetus be limited to a fraction of the occupational dose limit.

5. What are the potentially harmful effects of radiation exposure to my embryo/fetus?

The occurrence and severity of health effects caused by ionizing radiation are dependent upon the type and total dose of radiation received, as well as the time period over which the exposure was received. See Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Exposure" (Ref. 3), for more information. The main concern is embryo/fetal susceptibility to the harmful effects of radiation such as cancer.

6. Are there any risks of genetic defects?

Although radiation injury has been induced experimentally in rodents and insects, and in the experiments was transmitted and became manifest as hereditary disorders in their offspring, radiation has not been identified as a cause of such effect in humans. Therefore, the risk of genetic effects attributable to radiation exposure is speculative. For example, no genetic effects have been documented in any of the Japanese atomic bomb survivors, their children, or their grandchildren.

7. What if I decide that I do not want any radiation exposure at all during my pregnancy?

You may ask your employer for a job that does not involve any exposure at all to occupational radiation dose, but your employer is not obligated to provide you with a job involving no radiation exposure. Even if you receive no occupational exposure at all, your embryo/fetus will receive some radiation dose (on average 75 mrem (0.75 mSv)) during your pregnancy from natural background radiation.

The NRC has reviewed the available scientific literature and concluded that the 0.5 rem (5 mSv) limit provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers. If this dose limit is exceeded, the total lifetime risk of cancer to the embryo/fetus may increase incrementally. However, the decision on what level of risk to accept is yours. More detailed information on potential risk to the embryo/fetus from radiation exposure can be found in Refs. 2-10.

8. What effect will formally declaring my pregnancy have on my job status?

Only the licensee can tell you what effect a written declaration of pregnancy will have on your job status. As part of your radiation safety training, the licensee should tell you the company's policies with respect to the job status of declared pregnant women. In addition, before you declare your pregnancy, you may want to talk to your supervisor or your radiation safety officer and ask what a declaration of pregnancy would mean specifically for you and your job status.

In many cases you can continue in your present job with no change and still meet the dose limit for the embryo/fetus. For example, most commercial power reactor workers (approximately 93%) receive, in 12 months, occupation radiation doses that are less than 0.5 rem (5 mSv) (Ref. 11). The licensee may also consider the likelihood of increased radiation exposures from accidents and abnormal events before making a decision to allow you to continue in your present job.

If your current work might cause the dose to your embryo/fetus to exceed 0.5 rem (5 mSv), the licensee has various options. It is possible that the licensee can and will make a reasonable accommodation that will allow you to continue performing your current job, for example, by having another qualified employee do a small part of the job that accounts for some of your radiation exposure.

9. What information must I provide in my written declaration of pregnancy?

You should provide, in writing, your name, a declaration that you are pregnant, the estimated date of conception (only the month and year need be given), and the date that you give the letter to the licensee. A form letter that you can use is included at the end of these questions and answers. You may use that letter, use a form letter the licensee has provided to you, or write your own letter.

10. To declare my pregnancy, do I have to have documented medical proof that I am pregnant?

NRC regulations do not require that you provide medical proof of your pregnancy. However, NRC regulations do not preclude the licensee from requesting medical documentation of your pregnancy, especially if a change in your duties is necessary in order to comply with the 0.5 rem (5 mSv) dose limit.

11. Can I tell the licensee orally rather than in writing that I am pregnant?

No. The regulations require that the declaration must be in writing.

12. If I have not declared my pregnancy in writing, but the licensee suspects that I am pregnant, do the lower dose limits apply?

No. The lower dose limits for pregnant women apply only if you have declared your pregnancy in writing. The United States Supreme Court has ruled (in *United Automobile Workers International Union v. Johnson Controls, Inc.*, 1991) that “Decisions about the welfare of future children must be left to the parents who conceive, bear, support, and raise them rather than to the employers who hire those parents” (Ref. 7). The Supreme Court also ruled that your employer may not restrict you from a specific job “because of concerns about the next generation.” Thus, the lower limits apply only if you choose to declare your pregnancy in writing.

13. If I am planning to become pregnant but am not yet pregnant and I inform the licensee of that in writing, do the lower dose limits apply?

No. The requirement for lower limits applies only if you declare in writing that you are already pregnant.

14. What if I have a miscarriage or find out that I am not pregnant?

If you have declared your pregnancy in writing, you should promptly inform the licensee in writing that you are no longer pregnant. However, if you have not formally declared your pregnancy in writing, you need not inform the licensee of your nonpregnant status.

15. How long is the lower dose limit in effect?

The dose to the embryo/fetus must be limited until you withdraw your declaration in writing or you inform the licensee in writing that you are no longer pregnant. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

16. If I have declared my pregnancy in writing, can I revoke my declaration of pregnancy even if I am still pregnant?

Yes, you may. The choice is entirely yours. If you revoke your declaration of pregnancy, the lower dose limit for the embryo/fetus no longer applies.

17. What if I work under contract at a licensed facility?

The regulations state that you should formally declare your pregnancy to the licensee in writing. The licensee has the responsibility to limit the dose to the embryo/fetus.

18. Where can I get additional information?

The references to this Appendix contain helpful information, especially Ref. 3, NRC's Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure" for general information on radiation risks. The licensee should be able to give this document to you.

For information on legal aspects, see Ref. 7, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children – What Can the Employer Do?" which is an article in the journal *Radiation Protection Management*.

You may telephone the NRC Headquarters at (301) 415-7000. Legal questions should be directed to the Office of the General Counsel, and technical questions should be directed to the Division of Industrial and Medical Nuclear Safety.

You may also telephone the NRC Regional Offices at the following numbers: Region 1, (610) 337-5000; Region II (404) 562-4400; Region III, (630) 829-9500; and Region IV, (817) 860-8100. Legal questions should be directed to the Regional Counsel, and technical questions should be directed to the Division of Nuclear Materials Safety.

References for Appendix B & C Reports

1. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.
2. International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Ann. ICRP 21: No. 1-3, Pergamon Press, Oxford, UK, 1991.
3. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.[1] (Electronically available at www.nrc.gov/NRC/RG/index.html)
4. Committee on the Biological Effects of Ionizing Radiations, National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation* (BEIR V), National Academy Press, Washington, DC, 1990.
5. United Nations Scientific Committee on the Effects of Atomic Radiation, *Sources and Effects of Ionizing Radiation*, United Nations, New York, 1993.
6. R. Doll and R. Wakeford, "Risk of Childhood Cancer from Fetal Irradiation," *The British Journal of Radiology*, 70, 130-139, 1997.
7. David Wiedis, Donald E. Jose, and Timm O. Phoebe, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children – What Can the Employer Do? *Radiation Protection Management*, 11, 41-49, January/February 1994.
8. National Council on Radiation Protection and Measurements, *Considerations Regarding the Unintended Radiation Exposure of the Embryo, Fetus, or Nursing Child*, NCRP Commentary No. 9, Bethesda, MD, 1994.
9. National Council on Radiation Protection and Measurements, *Risk Estimates for Radiation Protection,* NCRP Report No. 115, Bethesda, MD, 1993.
10. National Radiological Protection Board, *Advise on Exposure to Ionizing Radiation During Pregnancy*, National Radiological Protection Board, Chilton, Didcot, UK, 1998.
11. M. L. Thomas and D. Hagemeyer, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 1996," Twenty-Ninth Annual Report, NUREG-0713, Vol. 18, US.

Safety Procedures

Only you can make your experience a safe one. Most accidents are caused by unsafe acts of the person involved. Because of the nature of some of the activities at the hospital, it is of vital importance that each student become well-acquainted with the hazards involved in the operations of this department to protect him/herself, his/her coworkers, and his/her patients and to effectively safeguard hospital equipment and property.

It is important that you observe safe practices, keep your clinical area clean, and actively participate by suggesting improvements that will help make your clinical experience a safe one.

In the case of an accident, an incident report must be filled out and forwarded to the department Administrative Director immediately. Should the incident involve a patient, the patient is not to be sent away until seen by a physician. Appropriate care must be administered and the incident report should be signed by the involved patient. The program director is to be informed immediately, even if the incident appears to be of minor significance.

Incident Reports

All incidents involving patients, visitors, students, or faculty/staff must be documented via a written incident report on forms provided.

Patient/Visitor Incident

Where real or potential injury occurs, medical attention must be provided immediately. All involved persons must inform the clinical supervisor as soon as possible. In the event a student is involved the program director should be notified. A patient incident report form is to be filled out by the student and given to the clinical supervisor.

Student Incident

In the event that a student is injured or suspectedly exposed to a communicable disease, the student is to notify the program director. The student is to obtain a release form from a physician before returning to the clinical area. A copy of this release form is to be maintained in the student's folder.

Health Status

For the student to maintain his/her own health, it is necessary for him/her to have adequate health insurance coverage. The student is responsible for the expenses associated with illnesses and/or injuries. Clinical sites will provide emergency care, but are not responsible for the expenses associated with that care. Each student must provide proof of health insurance at the time of matriculation.

Student Maltreatment

The UNC Hospitals Medical Dosimetry Program has a zero tolerance policy for maltreatment of any student. Maltreatment is defined as any of the following behaviors:

1. Public humiliation
2. Threats of physical or psychological harm
3. Requirements to perform personal service for another individual
4. Limiting opportunities, grades, or any other activities because of gender, race, religion, or sexual orientation
5. Sexual advances, remarks, or innuendos
6. Offensive racial or religious remarks or actions

In order to be sure that these activities do not occur, the following will be observed:

1. The policy will be disseminated to all current and new students/employees.
2. There will be an annual discussion of maltreatment with employees at faculty/staff meetings.
3. Any individual who experiences or observes evidence of others not following this policy is obligated to report this to the program director, clinical supervisor, or Administrative Director. The program director will make an independent decision based on the situation as to whether the action is best reported to a higher level.

Additional policies (those that follow) are covered in program orientation. The student also receives a background check, drug test, immunizations, an identification badge, and a personnel radiation monitor to protect his/her health and safety.

Graduation Requirements/National MDCB Certification Examination

Students who successfully complete the curriculum may be eligible to take the national certification examination offered by the MDCB through Route 1. Successful completion of this program does not guarantee the student is eligible to take this examination, since the MDCB reviews the applications and determines eligibility for the examination.

Questions regarding eligibility should be directed to the MDCB (mdcb.org). It is the responsibility of the student to apply for the certification examination. Applications usually take weeks to process.

Before a student enrolled in the UNC Hospitals Medical Dosimetry Program can be eligible to apply for the medical dosimetry examination or receive his/her certificate, he/she must fulfill the following requirements and obligations to UNC Hospitals:

1. The student must have successfully met the academic requirements of the program as established by the grading system and academic standards of the program.

2. The student must have his/her fees and any fines accumulated paid in full before he/she can receive credit for his/her courses.
3. A student that has exceeded his/her allowable personal days (up to 40 hours), must make compensation for this extra time. This will involve clinical assignments after the scheduled date of completion. Refer to the beforementioned requirements in this document.
4. The student must have completed all projects and required work before he/she will be allowed to officially graduate.
5. The student must return all property (i.e., books, identification badges, etc.) or remit financial compensation for lost property.

The entering student will graduate 12 full months following the entrance date, provided he/she has met the full requirements.

Release of Student Records

The student must sign a consent form to release his/her student records if he/she wants faculty/staff to provide verbal or written recommendations. Faculty may need to refer to student records to make recommendations. All student records are released under the federal guidelines of the Family Educational Rights and Privacy Act (FERPA 1974). Student records are maintained in a locked file cabinet. Students wishing to review any appropriate records should make an appointment with the program director. The student is encouraged to do such if he/she has any questions regarding his/her progress in the program (JRCERT Standard 1.5).

UNC Hospitals Medical Dosimetry Program Curriculum

The UNC Hospitals Medical Dosimetry Program curriculum is designed to integrate classroom and clinical education throughout the professional year. The student is limited to no more than 40 contact hours per week. The courses below must be taken in sequence, beginning with the fall semester.

Courses

MD 500 Orientation to Radiation Oncology 1 hour (12.5 contact hours)

This course provides the student with an overview of radiation therapy/medical dosimetry, and is taught during the initial weeks of the student's matriculation into the medical dosimetry program. The student will understand the student handbook and sign/date all policies and procedures. All medical, regulatory, and financial business will be completed. The student will be given department/hospital/campus tours, have pictures take, and meet different groups and individual within the department and greater organization. Included in the orientation are all health and safety policies, including radiation safety and protection. Most importantly, the student completes Lean training on good catches, A3s, kaizens, and other quality improvement tools. Finally, the student gives written and oral reports on medical dosimetry professionalism (Assessment Plan, Goal 4, Objective 3). Clinical orientation is also given during this initial period of time.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 501 Introduction to Medical Dosimetry 1 hour (12.5 contact hours)

This course is an introduction to medical dosimetry techniques in the UNC Department of Radiation oncology. This includes treatment charts, patient information flow, and basic and irregular field calculations. This course also covers the various quality assurance procedures performed in a radiation oncology department. Also included are various statistics topics to educate the student in becoming a good consumer of medical dosimetry research. Professional development, billing/coding, HIPAA, and professional service are also addressed.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 502 Medical Dosimetry Physics 3 hours (37.5 contact hours)

This course teaches basic theories and calculations for radiation therapy. It covers the following topics: radiologic physics, production of x-rays, radiation simulation and treatment machines, interactions of ionizing radiation, radiation measurements, dose calculations, computerized treatment planning, dose calculation algorithms, electron beam characteristics, and brachytherapy physics and procedures. In addition, imaging for radiation therapy, IMRT, stereotactic radiosurgery, special procedures, particle therapy, hyperthermia, and radiation safety. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Note: The student must complete the medical and physics resident course during the fall semester. Before beginning this course, the student will be given a 180-question physics examination to determine their medical physics knowledge.

MD 503 Brachytherapy Dosimetry 1 hour (12.5 contact hours)

This course teaches the physics of brachytherapy. It includes source characteristics, dosimetry systems, and dose calculations.

Prerequisite: A grade of C or better in MD 502.

MD 504 Research Methodology and Design Statistics I 3 hours (37.5 contact hours)

This course is an introduction to basic research concepts and statistics. Development of the research project begins. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 505 Research Methodology and Design Statistics II 3 hours (37.5 contact hours)

This course is a continuation of MD 504 with projects finalized. This course is 15 weeks in length.

Prerequisite: A grade of C or better in MD 504

MD 506 Clinical Education I 6 hours (360 contact hours)

This is the first of a three course sequence. During the three course sequence, the student completes clinical rotations including 3D, IMRT, brachytherapy, and quality assurance. The length of these rotations varies. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 507 Clinical Education II 6 hours (360 contact hours)

This is the second of a three course sequence. During the three course sequence, the student will complete clinical rotations including 3D, IMRT, brachytherapy, and quality assurance. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 15 weeks in length.

Prerequisite: A grade of C or better in MD 506

MD 508 Clinical Education III 6 hours (360 contact hours)

This is the third of a three course sequence. During the three course sequence, the student will complete clinical rotations including 3D, IMRT, brachytherapy, CyberKnife, and quality assurance. The length of these rotations varies. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 12 weeks in length.

Prerequisite: A grade of C or better in MD 507

MD 509 Radiation Safety and Protection 1 hour (12.5 contact hours)

This course is an introduction to the sources of radiation. It includes detection and measurement, source handling, surveys, maximum permissible doses, room design, and regulations.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 510 Anatomy for Radiation Oncology 1 hour (12.5 contact hours)

This course teaches human anatomy with an emphasis on sectional anatomy and topography as it applies to radiation therapy. Identification of cross-sectional anatomy at different anatomical locations within the human body is also reviewed.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 511 Radiation Oncology Pathology 1 hour (12.5 contact hours)

This course is an introduction to bodily responses to injury, including neoplasia, carcinogenesis, and staging/grading of tumors.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

MD 512 Special Topics in Radiation Oncology 3 hours (37.5 contact hours)

This course consists of various seminars associated with radiation oncology. Topics include treatment techniques of various cancers, technological advances in cancer treatment, cancer treatment trends, and the role of a medical dosimetrist.

Prerequisite: A grade of C or better in MD 503

MD 513	The Radiobiology of Radiotherapy	3 hours (37.5 contact hours)

This course is an overview of radiation and cancer biology as it applies to radiotherapy, and is taught by Dr. Elaine Zeman from our Division of Cancer Biology.

MD 514	Clinical Radiation Oncology	3 hours (37.5 contact hours)

This course is an overview of the different neoplasms in radiation oncology. The body is divided into sections for the content of this course.

Prerequisite: A grade of C or better in MD 500 and MD 501

Total: 43 hours

The student is encouraged to seek academic counseling from the program director/instructor on any problem that might interfere with acceptable academic progress. Failure to seek such counseling from any resources available to the student, and to establish communication on that matter with the program director, will disqualify the circumstances as valid reasons for poor performance and/or expression of attitudes. For specific or more involved counseling needs, the program director will direct the student to the appropriate resources.

Professional actions and attitudes, as set forth by the AAMD Code of Ethics, are as important as traditional academic standards in preparation to deliver a high standard of healthcare and service. A student may be judged unacceptable for continuation in the program, regardless of academic and/or clinical standing, when he/she has displayed a lack of professionalism with respect to patients, students, and faculty/staff. Although the following is not totally inclusive, the student's conduct at professional meetings/seminars is also considered. Although such activities may not be held on campus, the student is considered a representative of the program, hospital, university, and state while attending such functions and should conduct him/herself accordingly.

Course Sequence

Fall: Semester 1

MD 500	Orientation to Radiation Oncology	1.0 hr
MD 501	Introduction to Medical Dosimetry	1.0 hr
MD 509	Radiation Safety and Protection	1.0 hr
MD 510	Anatomy for Radiation Oncology	1.0 hr

MD 511	Radiation Oncology Pathology	1.0 hr
MD 504	Research Methodology and Design Statistics I	3.0 hrs
MD 506	Clinical Education I	6.0 hrs

Spring: Semester II

MD 502	Medical Dosimetry Physics	3.0 hrs
MD 505	Research Methodology and Design Statistics II	3.0 hrs
MD 507	Clinical Education II	6.0 hrs
MD 513	The Radiobiology of Radiotherapy	3.0 hrs
MD 514	Clinical Radiation Oncology	3.0 hrs

Summer: Semester III

MD 508	Clinical Education III	6.0 hrs
MD 512	Special Topics of Radiation Oncology	3.0 hrs
MD 503	Brachytherapy Dosimetry	1.0 hrs

MD 500 Orientation to Radiation Oncology

Fall 2018

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Monday (8:00 a.m. – 4:30 p.m.) and Tuesday (8:00 a.m. – 12:00 p.m.); First two days of orientation

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course provides the student with an overview of radiation therapy/medical dosimetry, and is taught during the initial week of the student's matriculation into the medical dosimetry program. The student will understand the student handbook and sign/date all policies and procedures. All medical, regulatory, and financial business will be completed. The student will be given department/hospital/campus tours, have pictures taken, and meet different groups and individual within the department and greater organization. Included in the orientation are all health and safety policies, including radiation safety and protection. Most importantly, the student completes Lean training on good catches, A3s, kaizens, and other quality improvement tools. Finally, the student gives written and oral reports on medical dosimetry professionalism (Assessment Plan, Goal 4, Objective 3). Clinical orientation is also given during this initial period of time.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Handouts are designed to guide the student through this course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 501 Introduction to Medical Dosimetry

Fall 2018

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Wednesday (8:00 a.m. – 4:30 p.m.) and Thursday (8:00 a.m. – 12:00 p.m.); Third and fourth days of orientation

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is an introduction to medical dosimetry techniques in the UNC Department of Radiation oncology. This includes treatment charts, patient information flow, and basic and irregular field calculations. This course also covers the various quality assurance procedures performed in a radiation oncology department. Also included are various statistics topics to educate the student in becoming a good consumer of medical dosimetry research. Professional development, billing/coding, HIPAA, and professional service are also addressed.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Handouts are designed to guide the student through this course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 501

Example

Goal: This lecture set will introduce the student to medical dosimetry. In addition, it will provide the student with background knowledge of dosimetry theory, equipment, and special considerations in medical dosimetry.

Objectives: At the end of this course, the student will:

1. Define the following terms: percentage depth dose, tissue maximum ratio, tissue phantom ratio, tissue air ratio, geometric and physical penumbra, scatter air ratio, monitor unit, rad, backscatter factor, isodose curve, and dose profile.
   Percentage depth dose – the maximum dose remaining at a particular depth in a phantom or patient; the percentage of the absorbed dose at any depth to the absorbed dose at a fixed reference depth
   Tissue maximum ratio – measured with a constant distance to the point of interest; defined as TMR = dose at depth d/dose at dmax

Tissue phantom ratio – use to develop depth dose charts
Tissue air ratio – ratio of dose in phantom to air; does not depend on SSD; defined as TAR = dose at given depth in phantom at SAD/dose without phantom at SAD
Geometric penumbra – exists both inside and outside the geometrical boundaries of the beam
Physical penumbra – the lateral distance between two isodose curves at a certain depth
Scatter air ratio – the ratio at a point in the radiation field of dose due to scatter and the dose in air at that point
Monitor unit – the basic unit of machine output
Rad – the unit of radiation absorbed dose
Backscatter factor – the component of dose at or near the surface of a phantom attributed to photons and secondary electrons from the medium recoiling back toward the direction of the incident photon
Isodose curve – lines passing through points of equal dose; demonstrates the characteristics of radiation beams
Dose profile – a graph of dose distribution produced by passing a dosimeter across the beam

2. Describe the major advantages and disadvantages of various dosimetry software systems.
   Most dosimetry software is developed and distributed commercially. It is typically a closed system. One is unable to add features desired by individual oncology departments. Changes cannot be made by a department such as updating a system or adding features.
3. Discuss the theory behind Clarkson calculations.
   Clarkson calculation is used when a block is added to the field and the scatter dose may be affected without affecting the primary dose. With the Clarkson calculation, the scattered component of the dose can be calculated separately from the primary dose. The Clarkson theory changes an irregularly shaped field to be calculated as if it were a circle.
4. Describe the mechanism of the RayStation system.
   RayStation is the treatment planning software implemented at UNC. It has separate modules for image acquisition, registration, contouring of anatomy, beam selection, placement, and shaping, dose computation, dose analysis, and dose optimization. It has fully integrated functions and allows multidirectional workflow. It allows an integration of digitally reconstructed radiographs with dose inhomogeneity computation and dose optimization. Beams may be shaped by blocks or MLCs. It also allows changes with wedges, compensators, and MLCs.
5. Discuss the application of CT and MRI in radiation therapy.
   Technology today is able to construct a 3D image of a patient using CT and MR scans. This 3D image is placed in the treatment planning computer and allows one to highlight the organs of interest such as the tumor or clinical structures. Beam directions may be modified until an optimal treatment plan is designed with minimal irradiation to normal tissues. Blocks may be designed in the computer. A digital radiograph is produced with

the actual treatment fields and set-up films. These features allow a greater degree of precision in treatment designs. Having the treatment plan designed before the simulation will help conserve and shorten time in the simulator.

CTs are only able to provide transverse axial images which may be reconstructed into three dimensions. MRI can directly scan in axial, sagittal, coronal, or oblique plans. With MRI, one is not using ionizing radiation to get the images. It also offers better contrast and imaging of soft tissue tumors.

6. Discuss the differing roles of medical physicists, medical dosimetrists, and radiation therapists.
   Physicists are responsible for the calibration and quality assurance of the treatment machines. They must ensure the accuracy of the machine and the emerging beam.

   Medical dosimetrists are responsible for determining the actual treatment plan and dose for each patient. They must design an optimal treatment plan to the target and, hopefully, cure the patient while minimizing the dose to normal structures. They determine the treatment angles, whether any blocks or compensators are in the beam, and the dose delivered for each field. Their role is now expanding because of the new technology of 3D planning and treatment planning systems.

   Radiation therapists are responsible for the treatment of cancer patients. They have daily contact with the patients and help monitor the side effects of the treatments on the patients. They are also responsible for accurately delivering the treatment and monitoring the patient.
7. Comprehend various methodologies for correcting tissue inhomogeneities.
   There are differing methods of correcting for inhomogeneities in tissue. These include wedges, blocks, compensators, and bolus. Wedges are used mostly for sloping surfaces. Blocks are used to prevent treatment to normal tissues. Compensators are useful for irregularly shaped treatment areas. Bolus is used to bring the dose closer to the surface and in the case of missing tissue in an area. There are also tissue inhomogeneities in fields with bone or air.
8. Describe the certification board and professional society for medical dosimetry.
   The certification exam consists of 165 very difficult questions. This exam is only given once a year and is given to those who have met the criteria as described by the MDCB Board of Directors. The professional society for medical dosimetrists is the AAMD.
9. Demonstrate beginning clinical dosimetry competence by completing planning sessions on the computer-based learning modules with faculty review.
10. Discuss the various methods by which anastructs are constructed and identified.
    Anastructs are used to differentiate between different tissues. RayStation is able to distinguish between soft tissue, bone, and air. It is also used to distinguish different

tissues and organs. Once they are distinguished, they may be shaded in with different colors to show the different organs.

11. Provide an overview of treatment planning techniques.
    Treatment planning techniques begin with image acquisition through CT and MR scans and then image registration. Different anatomy is contoured with the use of different shades and colors. Beam selection/placement/shaping may occur with blocks, MLCs, wedges, compensators, and IMRT. Dose computation of both photon and electron fields is based on inhomogeneities with dose optimization. Dose analysis utilizes isodose lines and surfaces, DVH, and EUD. Dose optimization uses different beams with weightings that limit dose to normal tissues and optimize dose to the tumor.
12. Demonstrate participation in procedures by providing a record of all procedures encountered during clinical rotation.

MD 502 Medical Dosimetry Physics

Spring 2019

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Tuesday (9:00 a.m. – 12:00 p.m.)

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course teaches basic theories and calculations for radiation therapy. It covers the following topics: radiologic physics, production of x-rays, radiation simulation and treatment machines, interactions of ionizing radiation, radiation measurements, dose calculations, computerized treatment planning, dose calculation algorithms, electron beam characteristics, and brachytherapy physics and procedures. In addition, imaging for radiation therapy, IMRT, stereotactic radiosurgery, special procedures, particle therapy, hyperthermia, and radiation safety. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Khan, F. *The Physics of Radiation Therapy*.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test performance (in class)	70%
Homework	30%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

<u>Honor Code</u>

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 502

Lecture Topics

Section 1: Radiologic Physics

Atomic and Nuclear Structure

A. Atomic structure
    1. Rest mass
    2. Energy
    3. Fundamental principles
    4. Atomic structure
    5. Atomic binding energy
    6. Atomic shell filling rules
    7. Transitions
    8. Energy level diagrams
    9. Characteristic radiation
    10. Auger electrons
    11. Fluorescent yield
B. Nuclear structure
    1. Mass, atomic, and neutron number
    2. Periodic Table of Elements
    3. Nuclear binding energy
    4. Fission, fusion
C. Radioactive decay
    1. Modes of decay
    2. Special types of nuclides
    3. Mathematics of radioactive decay
    4. Equilibrium
    5. Natural radioactivity

Production of X-rays

A. X-ray tubes
    1. Anode and cathode
    2. Focal spot size
    3. Reflection and transmission targets
    4. Heel effect
    5. X-ray emission spectrum
    6. Factors that affect the x-ray emission spectrum
    7. X-ray circuits
B. Physics of x-ray production
    1. Bremsstrahlung
    2. Characteristic x-rays
    3. X-ray energy spectra
    4. Operating characteristics
C. Simulators
    1. Conventional simulators
    2. CT simulators

Radiation Treatment and Simulation Machines

A. Kilovoltage units
B. Linear accelerators
    1. Major subsections
    2. Accelerator section
    3. Microwave power (magnetron, klystron)
    4. Bending magnet types
    5. Monitor chamber
    6. Photon beam production
        a. Target
        b. Flattening filter
        c. Collimation (including multileaf collimators)
        d. Beam profiles ("horns")
    7. Computer control system
    8. Electron beam production
        a. Scattering foil systems
        b. Scanning electromagnet systems
        c. Collimation
C. New machines
    1. ViewRay
    2. Vero

Interactions of Ionizing Radiation

A. Types of electromagnetic radiation
B. Properties of photons, relationship of energy and wavelength
    1. Direct and indirect ionizing particles
C. Photon interaction process, KERMA
    1. Attenuation and absorption coefficients
        a. Attenuation coefficients
        b. Transfer coefficients
        c. Absorption coefficients
D. Relationship of KERMA and absorbed dose
E. Attenuation in the body
F. Modes of interaction
    1. Coherent scattering
    2. Photoelectric absorption
    3. Compton scattering
    4. Pair production
    5. Triplet production
    6. Photodisintegration
    7. Energy dependence of interaction probabilities
    8. Attenuation in the human body
G. Interaction of particle radiation
    1. Heavy charged particles
    2. Interactions of electrons
    3. Interactions of neutrons

Radiation Measurements

A. Photon and energy flux density and fluence
B. The Roentgen
C. Electronic equilibrium
D. Ionization chambers
    1. Free-air chambers
    2. Thimble chambers
    3. Condenser chambers
        a. Stem effect
    4. Farmer chambers
    5. Parallel-plate chambers
    6. Extrapolation chambers
    7. Diode detectors
    8. Electrometers
        a. Integrate mode

b. Rate mode

E. Exposure calibration of x-ray or gamma-ray beams
   1. Section of calibration variables
   2. Selection of chamber
   3. Positioning of chamber
   4. Corrections to readings

External Beam Dosimetry Concepts

A. Dosimetric variables
   1. Inverse square law
   2. Backscatter factor
   3. Peak scatter factor
   4. Electron buildup
   5. Percent depth dose
      a. Mayneord f-factor
      b. TAR correction to f-factor
   6. Equivalent squares
   7. Tissue air ratio
   8. Scatter air ratio

System of Dose Calculations

A. Monitor unit calculations
   1. Output factor
   2. Field size correction factors
   3. Collimator scatter factor and phantom scatter factor
   4. Beam modifier factors
   5. Patient attenuation factors
B. Calculations in practice
   1. SSD technique
      a. SSD treatment same as SSD of calibration
      b. SSD treatment different from SSD of calibration
      c. SSD treatment and SAD calibration
   2. SAD technique
      a. SAD treatment and SAD calibration
      b. SAD treatment and SSD calibration
      c. SAD rotational treatment
C. Beam weighting
D. Arc rotation therapy
E. Irregular fields

Computerized Treatment Planning

A. Isodose curves (beam characteristics)
B. Skin dose
C. Parallel opposed beam combination
D. Wedge isodose curves
    1. Wedge angle and hinge angle
    2. Wedge factor
E. Wedge techniques
    1. Wedge pair
    2. Open and wedged field combination
    3. Skin compensation
F. Beam combination (3-, 4-, 5- etc. field techniques)
G. Dose-volume specification
    1. ICRU 50
        a. GTV, CTV, PTV
        b. Organs at risk
        c. Dose specification
    2. ICRU 62
        a. ITV
        b. Planning risk volume
        c. Conformity index

Electron Beam

A. Depth dose/isodose characteristics
    1. AAPM TG-25
B. Treatment planning with electrons
    1. Rules of thumb
    2. Selection of energy, field size
    3. Electron skin dose
    4. Electron bolus
    5. Electron field shaping
C. Field matching
    1. Electron-electron gapping
    2. Electron-photon gapping
D. Electron backscatter
E. Inhomogeneities and electrons

Dose Calculation Algorithms

A. Basic dose algorithms

1. Generation of isodoses
2. Irregular fields

B. Corrections for inhomogeneities
   1. Simple 1-D and 2-D methods
   2. Convolution methods
   3. Monte Carlo methods
   4. Dose perturbations at interfaces

3D CRT Including ICRU Concepts and Beam Related Biology

A. 3D CRT concepts – volumetric (3D CRT) vs. non-volumetric
   1. Technology and methods for planning (volume-based planning)
   2. Building patient models (image reconstruction and segmentation)
   3. Virtual simulation
   4. Implications of treatment variabilities
      a. Systematic and random set-up variability, patient breathing
      b. Contouring variability

B. Volumetric beam placement
   1. DRR generation
   2. BEV, DVH
   3. Non-coplanar beams
   4. Planning tools
      a. Biological implications of uniform vs. non-uniform dose delivery
      b. Non-biological and biological dose-volume metrics (DVHS, TCPs, NTCPs)
      c. Margins (PTVs, PRVs)

C. Treatment planning methods
   1. Beam selection
   2. 4D imaging and planning
   3. Dose reporting
   4. Volumetric vs. point prescriptions

Adjoining Fields and Special Dosimetry Problems

A. Two-field problem
B. Three-field problem
C. Craniospinal gapping
D. Peripheral dose
E. Pacemaker
F. Gonadal dose
G. Pregnant patient

H. Surface dose

Imaging for Radiation Oncology: MRI

A. Physical principles
   1. T1, T2, TE, TR imaging characteristics
   2. Advantages and limitations of MRI images for diagnosis and computerized treatment planning

Imaging: Nuclear Medicine, Ultrasound, EPID

A. Ultrasound
   1. Physical principles
      a. Utility in diagnosis and patient positioning
      b. PET imaging
B. PET
   1. Physical principles
      a. Utility for radiation therapy
      b. SPECT
C. Electronic Portal Imaging
   1. Overview of electronic portal imaging devices
   2. Types of portal imaging devices
   3. Clinical applications of EPID technology in daily practice

Imaging: Radiographic, CT, 4D

A. Diagnostic imaging
   1. Physical principles
   2. Port film imaging
   3. Film based
   4. XV-2 film, EDR-2 film characteristics
B. CT
   1. Physical principles
      a. Serial, helical
      b. Hounsfield units, CT numbers, inhomogeneity corrections based on CT scan images

Imaging: Fusion, Image Registration

A. Image fusion
   1. Advantages
   2. Challenges
   3. Techniques

        4. Limitations
B. Deformable body/structure image fusion
C. Quality assurance
    1. Image transfer process, accuracy, fidelity
    2. Image fusion process

IMRT

A. IMRT delivery systems
    1. Segmental MLC (SMLC) and dynamic MLC (DMLC)
    2. Serial TomoTherapy (MIMiC)
    3. Helical TomoTherapy
    4. Robotic linac
B. Simulation, dose prescription, and inverse planning
    1. Organ motion and IMRT (prostate, parotid, lung, patient weight loss during treatment, etc.)
    2. Treatment calculations
    3. Forward planned IMRT
    4. Compare/contrast various treatment planning software available
        a. How to distinguish a good IMRT plan vs. a poor IMRT plan
C. IMRT quality assurance
    1. Systematic QA
    2. Patient specific QA
    3. Record/verify
D. ViewRay
    1. Basic magnetic field and MRI concept review
    2. Overview of MRI-guided delivery systems
    3. Treatment planning
    4. Quality assurance for an MRI-guided delivery system
    5. ViewRay-specific operations issues (NRC overview, MRI safety, etc.)

Informatics

A. DICOM
B. PACS
C. Network integration and integrity
D. Storage and archival
E. IS maintenance

Stereotactic Radiosurgery

A. SRS delivery system
    1. Linac based

2. Gamma Knife
3. Robotic linac

B. Simulation and immobilization/repositioning
C. Dose prescription and treatment planning
D. Treatment calculations
E. SRS quality assurance

Particle Therapy

A. Protons
    1. Proton beam energy deposition
    2. Equipment for proton beam therapy
    3. Clinical beam dosimetry
    4. Clinical proton beam therapy
    5. Treatment planning
    6. Treatment delivery
    7. Clinical applications
    8. Clinical beam dosimetry
B. Other particles
    1. Carbon
    2. Neutrons
C. Biology
    1. LET
    2. RBE

Special Procedures

A. TBI
    1. Patient set-up
    2. Dosimetry
    3. Selection of energy, field size, distance
    4. MU calculations
B. ESRT
C. TSET
D. Electron arc

MD 502

Homework Questions

Note: All answers must be typed. There is a 5% reduction in grade for each 24 hour period from the due date. All due date times are 4:00 p.m. of the date assigned.

Atomic and Nuclear Physics

Due: August 3rd, 2018

1. How do atomic and nuclear energy levels differ?
2. Are atomic energy levels defined absolutely or in terms of probability? Explain your answer.
3. What is the Z number?
4. What does A represent?
5. What dose X represent?
6. What is the relationship between the number of neutrons and protons in stable nuclei?
7. What is the relationship between wavelength and frequency?
8. Are x-rays electromagnetic radiation?
9. What type of model is used to understand electromagnetic radiation?
10. What energy equation is used in terms of wavelength/frequency?
11. Give definition of the following terms:
    a. Activity
    b. Half life
12. Define the two terms and construct a model demonstrating transient and secular equilibrium.
13. When would radioactive equilibrium be achieved?
14. Describe positron emission and annihilation.
15. Is electron capture an alternative process to positron decay or negatron decay?
16. Define the process of internal conversion.
17. What is isomeric transition?
18. Distinguish between x and gamma rays.
19. Explain the difference between indirectly and directly ionizing radiation.
20. Determine whether x-rays and electrons are indirectly ionizing radiation, directly ionizing radiation, or both.
21. Define the following terms:
    a. Exposure
    b. Absorbed dose
    c. Roentgen
    d. cGy
    e. Becquerel
    f. Isotope
    g. Isomer
    h. Isobar
    i. Isomers

    j. Atomic mass unit
    k. Avogadro's Law
    l. Mass defect
    m. Binding energy of the nucleus
22. What is the formula that is the principle of equivalence of mass and energy?
23. What force does the strong nuclear force overcome that keeps the nucleus together?
24. What are the three series of radioactive elements?

<u>Types of Radiation</u>

Due: September 7th, 2018

1. What is ionizing radiation?
2. What is the lowest kinetic energy to call a type of radiation ionizing?
3. List the x-ray energies for the following radiation therapy terms:
    a. Grenz
    b. Contact
    c. Superficial
    d. Orthovoltage
    e. Megavoltage
4. What is the energy of a photon with the wavelength 0.001 nm?
5. What is the approximate range of alpha particles in tissue?
6. What is the energy range of protons in radiation therapy?
7. What is the approximate range in water of 150 MeV protons? 300 MeV deuterons? 100 MeV negative pions?
8. Is the Bragg peak for a pion sharper or broader than for a proton?

<u>Radiation Machines</u>

Due: October 5th, 2018

1. Which emits electrons, the cathode or the anode?
2. Are both the cathode and anode sealed in the glass tube and at high vacuum?
3. Which material is commonly used for the target?
4. Why is the target placed at an angle?
5. Why does the target rotate?
6. Name three designs for cooling of the target.
7. Are most modern x-rays systems self-rectified or fullwave rectified? Why?
8. What is the approximate efficiency of bremsstrahlung production in a 100 kVp system? What happens to the rest of the energy?
9. Does an x-ray tube produce monoenergetic photons or a spectrum of energies?
10. Why are diagnostic x-rays systems filtered?

11. The medical linear accelerator uses high power _____ waves to accelerate _____ particles to high energies.
12. Most accelerators today use the _____ wave design.
13. The thyratron is essentially a very high-power switch, and is used in the _____ to produce short pulses of high voltage, which are delivered to the _____ (or ______) and to the electron gun simulataneously.
14. Is the magnetron or klystron more commonly used in high energy linacs? Why?
15. Why is a flattening filter necessary for x-ray mode and scattering foils for electron mode?
16. What type of beam is most commonly produced in the cyclotron for radiation therapy?
17. Why is Co60 used as the only isotope teletherapy machine (think of the physical characteristics – half life, gamma, energy, specific activity)?

Interaction of Radiation with Matter

Due: November 2nd, 2018

1. What is ionization and how is it different from excitation?
2. How do photons ionize atoms?
3. If the half value layer of a photon beam is 5 cm in water, what is μ?
4. Is each successive half value layer equal to the preceding half value layer from a Cs137 source?
5. Briefly describe the photoelectric effect. How does the intensity of the photoelectric process vary with E? with Z?
6. Describe briefly the Compton effect. Does the photon stop and transfer all its energy? How does the Compton effect vary with Z? with electron density? with E?
7. Write the formula for the energy of the Compton scattered proton. What is the energy of a 5 MeV photon after scattering through an angle of 30 degrees? after an angle of 90 degrees?
8. Briefly describe the pair production process. What is the threshold energy for this process? Why are pair production events at this energy almost never seen in clinical applications? How does pair production vary with Z?
9. What is KERMA? How does it differ from absorbed dose? Which value is higher near the surface for a megavoltage beam?
10. What is the traditional unit of exposure? Is it formally defined for a 25 MV photon beam?
11. Graphically compare the measurement conditions for PDD, TAR, and TPR.
12. Where is field size defined for each measurement? Which parameter shows an inverse square effect?
13. Why would we be concerned about underdosing at the edge of a tumor which protrudes into the lung if treating with an 18 MV beam?
14. Do electrons interact with matter by processes similar to photons? Explain your answer.
15. When comparing the variation in effective beam energy with depth for a photon and electron beam, which beam becomes harder and why?

16. What is the approximate rate of energy change of megavoltage electrons in water?
17. Which beam would deliver a higher surface dose, 18 MeV or 7 MeV?
18. Why do we use applicators to collimate the electron beams almost all the way to the patient surface, but not for photons?
19. What would be the potential disadvantage of a lead sheet on the skin when treating a lesion close to a critical structure?
20. Assume you were planning an electron beam treatment to the left chest wall scar, and the beam geometry was such that the exit path would traverse bone (chest wall) then lung, then heart. If the determination of chest wall depth showed large variations and you would prefer to use 16 MeV rather than 9 MeV to ensure full coverage with the 90% isodose line, which physical effects of electron beam interactions should you reconsider? Name at least two.

<u>Measurement of Megavoltage Radiation Rotation</u>

Due: December 7th, 2018

1. Why must ionization chamber walls be "air equivalent?"
2. What are the outer dimensions of the farmer chamber's collecting volume?
3. If we wanted to check depth dose on isodose distributions, but did not have a scanning water tank system, which solid state dosimetry method would be most convenient?
4. If we used film for dosimetric measurements, which resolution would be worse, spatial resolution or dose resolution?
5. List five types of dosimetric data that we would need to measure in order to provide complete and accurate 2D dose calculations for all types of photon and electron fields?
6. How is the wedge angle defined? Is it the physical wedge's angle?

<u>Mathematical Modeling of Measured Doses</u>

Due: December 7th, 2018

1. Would you need to perform a scatter integration for an asymmetric field with no blocks? Explain.
2. What is head scatter and why does its value increase with field size?
3. What is tissue reference ratio (TRR), what physical processes are included in this factor, does the TRR have units, and how does it differ from TMR and TPR?
4. Does a national standard exist for the calculation of meter sets?
5. Why does the beam profile change with depth? Do all centers account for this in their meter set calculations?
6. Is the wedge factor a single, constant value for each wedge? Explain.
7. What would be some of the practical problems with treatment planning CT scans in the radiology CT scanner?
8. Describe the differences between 2-D, 2.5-D, and 3-D treatment planning.

9. The AAPM TG 40 report defines the accuracy goal in radiation oncology to 5% overall. From the following four steps, state the uncertainty in percentage:
    a. Localization
    b. Simulation
    c. Dosimetry
    d. Oncologists
    e. Treatment
10. How much uncertainty is allowed in patient data measurements?
11. Define the following terms:
    a. Gross tumor volume
    b. Clinical target volume
    c. Planning target volume
    d. Treatment volume

<u>Alpha and Omega</u>

Due: December 7th, 2018

1. Describe the variation of dmax with field size.
2. How does the depth dose change with increasing TSD?
3. What would be an advantage and a disadvantage of treating a mantle technique with 18 MV?
4. If a patient had a separation of 30 cm, would 18 MV or 6 MV be a better treatment energy and why?
5. If a target volume is centered in the body and treated AP/PA, and the tumor volume extends to 1 cm from the field edges, would the entire target volume receive 100% of the treatment dose? Why?
6. When two fields are at 90 degree angles relative to each other, would the resulting dose distribution be uniform in the intersecting volume? Using the antiquated hinge angle formula, what would your calculated wedges be?

External Electron Beams

1. How does surface dose vary with electron beam energy?
2. How does electron depth dose change with increasing TSD?
3. What would be a good rule of thumb for lateral distance from the light field edge to the 90% isodose line?
4. Based on #3 above, what would be the smallest advisable light field dimension for assuring a reliable daily dose to a measurable area?
5. Can the photon field matching formula be applied to electron beams? What are the depths: 90%, 80%, and 0%?

Brachytherapy

1. Calculate the exposure rate produced by a 15 mg radium source at a distance of 30 cm.
2. Draw how an anistrophic distribution would look emanating from a radium source.
3. Calculate the activity of Co60 needed to produce the same exposure as 20 mg radium.
4. A radium treatment consists of 1200 mg-hrs. If the same treatment is given using 30 mCi of Cs-137, how long will be implant last?
5. If 1200 mg-hrs are needed to complete the implant in #4 above, how much gold would be required (for a permanent implant)?
6. A radon source is left on a counter for several months. Calculate the total exposure to appoint in the next room if the initial rate was 12 mR/hr.

MD 503 Brachytherapy Dosimetry

Summer 2018

Course Instructor
Eric Schreiber, PhD
Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology Administration, B Level
Phone: (984) 974-8427
E-mail: eric_schreiber@med.unc.edu

Location: NC Cancer Hospital, Radiation Oncology classroom, M Level

Course Description

This course teaches the physics of brachytherapy. It includes source characteristics, dosimetry systems, and dose calculations.

Prerequisite: A grade of C or better in MD 502.

Required Text and Handout Materials

Khan, F. *The Physics of Radiation Therapy*.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test performance (in class)	80%
Assignments	20%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 503

Course Sequence

Brachytherapy Principles

A. Handling of sealed radioactive sources
B. Dose distributions for sealed implant sources
C. Radium and radium substitutes
    a. Radium source specification
    b. Radium source types
    c. Exposure rate constant
    d. Exposure rate calculations
    e. Disadvantages of radium
D. Sealed source production and decay mechanisms
E. Other sealed sources in therapy
F. Unsealed source production and decay mechanisms
G. Converting between mgRaEq and mCi
H. Remote afterloading units
    a. Low dose rate (LDR)
    b. High dose rate (HDR)
    c. Calibration

Brachytherapy Dosimetry

A. Point source calculations
B. Linear source calculations
    a. Sievert integral
    b. Approximations
    c. Along and away tables
    d. TG-43 formalism

HDR Procedures

A. Afterloader principles
B. Source and transfer system design
C. Treatment sites
D. Treatment planning
E. Quality assurance

Brachytherapy Intracavitary

A. Linear source implant calculations
    a. Along and away tables

B. Intracavitary applications
    a. Cylinders
        i. Surface dose and cylinder size
    b. Tandem and ovoid
        i. Classical intracavitary dosage systems
            1. Prescription points
            2. Dosage systems
C. ICRU Report 38 – Dose Reporting
    a. Source information
    b. Applicator information
    c. Source strength
    d. Reference volume
    e. Reference point doses
    f. Time-dose patterns

Interstitial Implants

A. Paterson-Parker system
    a. Planar implant
    b. Volume implant
B. Quimby system
    a. Planar implant
    b. Volume implant
C. Paris system

Prostate, Breast, Eye Brachtherapy Implants

A. I-125, Pd-103 for prostate
B. HDR for prostate
C. HDR for breast
D. Eye applicators, plaques
    a. COMS protocol
    b. Sr-90 applicators

Radiopharmaceutical

A. Methods of production and clinical treatments
    a. Reactor-produced isotopes
    b. Cyclotron-based production
    c. Isotope decay characteristics
    d. Radiochemistry basic
B. Clinical treatments using internally administered radioisotopes
    a. Iodine treatment for thyroid

b. Radioimmunotherapy
c. Microspheres
d. Emerging treatments

C. Internal dosimetry and safety
   a. Dosimetry systems
   b. Compartmental models
   c. MIRD method
   d. Dose estimates for embryo/fetus and breast-feeding infant
      i. Radiation safety
   e. Equipment
      i. Survey meters, NaI probes, well counters, radionuclide calibrators
      ii. Instrument quality controls and checks
   f. Safety procedures
      i. Radiation protection
      ii. Internal protection
      iii. Decontamination
      iv. Written directive/medical event
      v. Package receipt
      vi. Area surveys
      vii. Regulations

MD 504 Research Methodology and Design Statistics I

Fall 2018

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Thursday (1:00 p.m. – 4:00 p.m.)

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is an introduction to basic research concepts and statistics. Development of the research project begins. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Handouts are designed to guide the student through the course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Note: A grading rubric will be given to the student.

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

Guidelines for Research Papers

Introduction: Requirement and Options

This document addresses the particular conditions under which the medical dosimetry student is to meet the requirements of the knowledge, skills, and abilities associated with the research paper.

Rationale

The purposes of the research paper are:

1. To gain an in-depth understanding of a medical dosimetry-related issue or problem
2. To gain a critical appreciation for available relevant literature
3. To develop and implement the skills necessary to:
    a. Formulate a researchable problem
    b. Locate, summarize, and cite pertinent literature
    c. Prepare a research protocol, including the selection of a methodology for the collection, analysis, and reporting of information
    d. To determine, locate, and assess the appropriateness of data necessary and available to answer the question/solve the problem, and
    e. Analyze, interpret, and present the data
4. To have the opportunity to integrate the knowledge and skills required through course materials, by applying didactic and clinical knowledge to a subject of particular interest to the student, and in a manner to prepare the student for similar professional tasks after graduation
5. To strengthen communication skills, and
6. To develop and enhance professional self-confidence

Character of the Paper

The research paper is a serious piece of research, analysis, and writing, whose purpose is to foster an understanding and application of the scientific method as a basis for studying problems in medical dosimetry. Moreover, it serves to demonstrate the student's ability to organize a study logically and systematically, as well as to present it in accurate and coherent writing.

Building on the student's work, the research paper begins with a question in the mind of the student (researcher), and continues with the following:

1. The expression of the question in the form of a problem, stated in clear, unambiguous terms, and buttressed by a review of the literature that is pertinent to the problem
2. A hypothesis, or educated conjecture, that will give direction to the student's thinking while examining the question
3. A plan, or design, for exploring the problem and its appropriate sub-problems

4. The collection of data/generation of information, and
5. An analysis of the data/information, organized into meaningful aggregates and appropriately interpreted

This paradigm of the research process has been further simplified into five questions that the paper is to explain and answer in the main sections indicated:

What is the question/problem?	**Problem Statement**
What is/was known about it?	**Literature Review**
How will/did we find out more?	**Research Design**
What did we find?	**Data Presentation and Analysis**
What do the findings mean?	**Conclusions and Implications**

These elements of the research paper are to be reflected in the student's paper.

Types of Papers

Four types of papers are described in the following paragraphs.

Hypothesis Testing

This type of research involves the study of causal relationships: why things are as they are (or how they might be different than they are). Studies may be directed to the effects (or feasibilities or utilities) of programs, emerging technologies, or interventional strategies such as patient education. Almost invariably, this type of research requires the use of substantial amounts of quantitative data, which may be primary (collected by the student) or secondary (use of existing data). Any of a broad variety of research designs – experimental, quasi-experimental, and non-experimental – may be used.

Bibliography-based Descriptive Studies

This type of research is in the tradition of the scholarly treatise, drawing upon documentary material (published or unpublished). The contribution of this type of research to the field of medical dosimetry is the development of fresh synthesis of ideas and information, which can serve to further understand issues and conditions, as well as provide a basis for the generation of hypotheses for further research. It is expected that, because the paper is mainly a literature review, the source information consulted and used will be extensive and exhaustive.

Organizational Problem Analysis

This type of research, usually cited in one or more specific organizations, is directed to the exploration/solution of a problem or method, resources, or intervention. As with other types, the problem orientation and the point of departure for solution as based on a search of the relevant literature. A wide variety of research designs may be drawn upon, also including the case study. Almost invariably, these studies depend strongly on the collection of primary data/information to identifying the outcomes of the solution.

Data-based Descriptive Studies

This type of research is aimed at describing a situation and finding out what the state of affairs is, with or without some explanatory elements. Its utility is mainly in gaining knowledge and understanding of problems, needs, and constraints (attitudinal and objective). It may be directed toward problematic aspects of medical dosimetry practice and the environment. Conduct of such studies usually involves the collection of survey data, with analysis at varying levels of statistical sophistication. Like the preceding types, these studies require extensive review of the literature to gain insights into the structure of problems, so as to identify the variables on which data are to be collected.

Advisement

All papers are developed under the advisement of a qualified member of the UNC Department of Radiation Oncology faculty/staff.

The paper must be judged acceptable to fulfill the program's requirements by both the faculty advisor and the second reader.

Selecting the Paper Topic

Each student, in consultation with and with the approval of the faculty/staff advisor, decides upon the topic of the paper to be completed. The student should selected a topic in which his or her interest is sufficient to maintain a high level of motivation and satisfaction throughout the research endeavor. Conducting the research and preparing the paper often requires more work and takes more time than the student anticipates, and so the topic should be one of personal or professional importance.

Specifications of the Paper

The paper should, in general, include the elements below. However, in papers of the bibliography-based descriptive studies type, the elements with an asterisk may require substitutions.

Title page

Abstract

Table of contents

Introduction, including a statement of the problem studied and the significance of the topic for medical dosimetry

Literature review, including substantive summaries of the major subjects and a statement that defines the point from which the original investigation begins

Research design and methodology

Presentation of all data/information

Analysis and interpretation of data and statement of findings

Conclusions regarding the significance of the findings for the problem, for further studies, and for the field of medical dosimetry

References/bibliography

Appropriate appendices

Format

Approximate length of the paper will range from 8-20 pages. Appropriate length of the paper is judged by the nature of the topic and the need to give adequate attention to all specified elements of the paper rather than to any pre-established standard.

All papers should be prepared with the standards of journal publication in mind. If judged appropriate by the faculty/staff advisor, the paper may be submitted in the form of an article-length manuscript.

The form and style of the paper may follow that of the American Medical Association.

The paper should be typed on 8 ½'' x 11'' white paper, double spaced.

Expenses

All expenses related to the research paper are the responsibility of the student

Publications Resulting from the Papers

In many cases the faculty/staff advisor and the second reader – and perhaps others – may play a significant role in guiding the student through the development of the paper.

Publications resulting from the paper may, therefore, raise questions with regard to publication credit.

Responsibilities in the Paper Process

The student is responsible for the following:

1. selecting the type and topic of the paper with the concurrence of the advisor, and
2. conducting the research and writing the paper.

MD 505 Research Methodology and Design Statistics II

Spring 2019

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Thursday (1:00 p.m. – 4:00 p.m.)

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is a continuation of MD 504 with projects finalized. This course is 15 weeks in length.

Prerequisite: A grade of C or better in MD 504

Required Text and Handout Materials

Handouts are designed to guide the student through the course.

Grading and Assignments

The grading for this course is different from other courses. Course grades are subject to quality. All work must be submitted by the required deadlines. These deadlines will be discussed during the first week of class. Primary classroom activities will be independent research, writing, and individual and collective meetings. It is the student's responsibility to manage his/her time wisely, as the course is predominantly independent study. The student is required to meet a minimum of three times for one-on-one instructor evaluation. It is the student's responsibility to schedule these dates and times.

Note: See the grading rubric for MD 504

Attendance and Special Assistance

Course attendance is strongly recommended. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances. Any student who feels the need for extra support for studying or test taking should notify the instructor as soon as possible.

Honor Code

The University of North Carolina's Honor Code is recognized and enforced in this course. The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 506 Clinical Education I

Fall 2018

Course Instructors
UNC certified medical dosimetrists

Monday, Wednesday, Friday (8:00 a.m. – 4:30 p.m.)

Location: NC Cancer Hospital, Radiation Oncology, M Level

Course Description

This is the first of a three course sequence. During the three course sequence, the student completes clinical rotations including 3D, IMRT, brachytherapy, and quality assurance. The length of these rotations varies. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 15 weeks in length.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Objectives:

The course is designed to do the following:

1. Introduce the student to basic clinical operations
2. Teach the student basic (3D) medical dosimetry procedures in laboratory sessions
3. Introduce the student to various quality assurance procedures
4. Introduce the student to the performance of various clinical procedures; simulations linked with treatment planning
5. Allow the student to perform under direct supervision less complex set-ups with treatment planning
6. Demonstrate an understanding of the basic clinical concepts of medical dosimetry
7. Demonstrate an understanding of theory and principles of operation of treatment planning computers
8. Demonstrate an understanding of the different types of radiation production
9. Understand and calculate radiation attenuation and decay
10. Demonstrate an understanding of the different types of radiation detectors
11. Demonstrate a basic understanding of treatment planning
12. Demonstrate an understanding of the role of a medical dosimetrist

Note: Clinical time must be recorded on a clinical time sheet with the clinical instructor's initials.

Grading and Assignments

Clinical competencies	50%
Overall evaluations	35%
Weekly writing assignments	10%
Self evaluations	5%

The student must complete 5 clinical competencies by the end of the semester. Competencies are graded pass/fail. To complete a clinical competency is considered to be a numerical grade of 100.

Note: All medical dosimetry calculations and treatment plans must be approved by a UNC certified medical dosimetrist prior to implementation on a treatment machine.

Weekly Writing Assignments - Fall

Due by e-mail to the program director no later than 5:00 p.m. each Monday. Begins July.

In 1 double-spaced page (Times New Roman, 12 pt, 1 inch margins), please respond to the following questions. You may write in the first person.

Week 1

As you complete your first week of clinical, of what are you most scared? To what are you most looking forward?

Week 2

As you complete your second week of class, of what are you most scared?

Week 3

Get to know a medical dosimetrist. Where is he/she from? Where did he/she attend school (medical imaging, radiation therapy, and/or medical dosimetry)? What does he/she do for fun? Why did he/she pursue a career in medical dosimetry? How long has he/she been a medical dosimetrist? In his/her opinion, what is the most rewarding part of his/her job?

Week 4

In your opinion, what are the most important qualities for a medical dosimetrist to possess? Which will be the hardest for you to develop?

Week 5

Pick a patient (male or female). Describe his/her tumor(s) (location, stage, grade). Describe his/her set-up. Describe his/her treatment plan. Why is this plan the best for him/her?

Week 6

Describe your most interesting case this week. The patient must be male.

Week 7

Describe your most interesting case this week. The patient must be female.

Week 8

What is the most significant problem you have seen a medical dosimetrist overcome? What was the problem? How did he/she handle the situation? What was the outcome?

Week 9

It has been a busy day in the clinic. The medical dosimetrist you are working with is tired and ready to go home. You see that he/she is about to make a mistake. What should you, as a student, do? Explain the importance of effective communication in this situation.

Week 10

You are approached by a radiation therapy student, interested in applying to a medical dosimetry program. Sell him/her the experience.

Week 11

Make the most of your clinical rotation this week. Do something you have never done before. Describe this experience and how it made you feel. Will you include this in your daily/weekly/rotational routine? Why or why not?

Week 12

Describe your most favorite and least favorite aspects of your current clinical rotation. Are there things you can do to make your experience a more positive one? Are there things others can do?

Week 13

Explain the roles of compassion, advocacy, and presence in radiation therapy. Tell about times when you or the medical dosimetrist(s) you were working with showed compassion, advocated for a patient/cause, and exhibited presence in the workplace.

Week 14

What were your misconceptions about the program? about the role of a medical dosimetrist? about the field of medical dosimetry?

Week 15

Looking back on this semester, of what are you most proud? What do you hope to accomplish next semester?

Weekly Writing Assignments – Spring

Week 1

As you begin your second semester, of what are you most scared? To what are you most looking forward?

Week 2

You are a radiation therapy patient. Describe your experience from diagnosis to follow-up.

Week 3

Pick a patient (male or female). Describe his/her tumor(s) (location, stage, grade). Describe his/her set-up. Describe his/her treatment plan. Why is this plan the best for him/her?

Week 4

Describe your most interesting case this week. The patient must be male.

Week 5

Describe your most interesting case this week. The patient must be female.

Week 6

Describe your most difficult patient to date. Why was he/she and his/her set-up/plan so difficult? What did you do to make his/her treatment easier?

Week 7

Describe one or more potential errors. Did you/would you report this/these errors? To whom? What did/could you do to prevent this/these errors?

Week 8

Now that you are well into your second semester, how has your confidence changed? Are you comfortable in the clinical setting? What is something you feel you do well?

Week 9

Describe your most embarrassing clinical experience. What did you learn?

Week 10

When performing a competency, what makes you most nervous? What competency was hardest for you to complete?

Week 11

How has your empathy for cancer patients changed? For patients' families?

Week 12

Get to know a medical dosimetrist (not the one you interviewed last semester). Where is he/she from? Where did he/she attend school (medical imaging, radiation therapy, and/or medical dosimetry)? What does he/she do for fun? Why did he/she pursue a career in medical dosimetry? How long has he/she been a medical dosimetrist? In his/her opinion, what is the most rewarding part of his/her job?

Week 13

What are the advantages of your current clinical site (UNC)? What do you like most? What do you like least?

Week 14

Which dosimetrist has been most beneficial to your learning experience? Why?

Week 15

Looking back on this semester, of what are you most proud? What do you hope to accomplish next semester?

Clinical Rotation Goals

The student will learn clinical practices through direct clinical experiences. The student, clinical instructor, and program director will provide ongoing assessment throughout the program.

Goals

Brachytherapy

The student will be capable of preparation, treatment, and follow-up of the brachytherapy patient. The student will act in the role of the brachytherapy technologist, medical dosimetrist, and medical physicist as related to brachytherapy cases.

Dose Calculation/Chart Review

The student will perform dose calculations and review charts for consistency among prescription, calculation, and daily treatment record.

External Beam Treatment Planning

The student will evaluate the patient's case, consider the physician's prescription, delineate the normal structures on the CT/MR images, utilize virtual simulation software, optimize a plan for treatment, discuss the plan with a dosimetrist, physician, and radiation therapist, document the patient's set-up and plan, use patient measurements and set-up parameters to calculate fields for treatment, and enter set-up notes and dose into the treatment verification computer system.

CyberKnife

The student will observe/perform quality assurance procedures for CyberKnife treatments, work with the medical physicist and radiation oncologist/neurosurgeon to generate a treatment plan, and observe planning and treatment of CyberKnife patients.

IMRT

Using IMRT capable treatment planning systems, the student will plan a variety of IMRT cases, including organ delineation, verifying the reference point, reviewing the target volume definition and prescription with the radiation oncologist, verifying the plan with the medical dosimetrist, performing treatment machine quality assurance with the medical physicist, and documenting the plan for treatment. The student will assist the radiation therapists in the treatment of a few patients.

Quality Assurance

The student will participate in quality assurance for all treatment and simulation machines that are available. The student will perform and document daily, weekly, monthly, and annual quality assurance procedures on the linear accelerators to include mechanical checks, output checks, calibration measurements, and laser checks.

CLINICAL TIME SHEET

NAME: ____ CLINICAL ROTATION: ____________________________________

*Time sheet is to be kept current at all times and turned in at the end of the rotation.

*Indicate: Number of hours present when present; Number of hours absent when absent. H = Holiday; P = Personal Day; I = Interview Day

*Five personal days are specified during the program year. If you are absent for any additional time, the time must be made up.

*Failure to comply with the hours assigned by your clinical site will affect your clinical grade.

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hours Present	Hours Absent	Hours Made Up (+ Date)	Preceptor Initials
July																																			
August																																			
September																																			
October																																			
November																																			
December																																			
January																																			

STUDENT SIGNATURE: ____________________________________ DATE: ____

Clinical Log Sheet

Student name: ___________________________________

Semester: ___________________________________

<u>Procedure</u>

Self Evaluation

Considering your level of experience, evaluated yourself according to the following criteria. Comments and suggestions are very important components of evaluation feedback, so please include when possible.

	Weak				Strong
PATIENT CARE SKILLS patient safety, patient comfort, awareness of patient condition, patient radiation protection COMMENTS:	1	2	3	4	5
TREATMENT PLANNING SKILLS psychomotor skills, use of treatment planning software COMMENTS:	1	2	3	4	5
CHART SKILLS Chart interpretation, documentation COMMENTS:	1	2	3	4	5
ORGANIZATIONAL SKILLS preparation for patients, prioritizing plans/patients, following through with all aspects of treatment planning COMMENTS:	1	2	3	4	5
PATIENT CARE SKILLS patient safety, patient comfort, awareness of patient condition, patient radiation protection COMMENTS:	1	2	3	4	5
TEAMWORK SKILLS communication skills, motivation, dependability, assists staff and other students COMMENTS:	1	2	3	4	5

Evaluation of Clinical Environment

Rotation: ___________________________________ Dates: ________________________

Clinical Instructor: ____________________________________

Please evaluate your clinical environment considering the following criteria:

Clinical Staff

	Never	Rarely	Sometimes	Often	Always
Maintains a friendly, professional attitude towards students	1	2	3	4	5
Maintains a professional attitude towards his/her career, speaks positively about students entering the profession	1	2	3	4	5
Demonstrates and explains software/equipment	1	2	3	4	5
Demonstrates and explains plans/techniques	1	2	3	4	5
Encourages students to ask questions	1	2	3	4	5
Encourages students to attempt plans with supervision	1	2	3	4	5
Points out items of importance, assists in correcting errors	1	2	3	4	5
Encourages an environment conducive to learning, is patient, considerate, and helpful	1	2	3	4	5

Clinical Environment

The clinical area had a steady patient flow.	1	2	3	4	5
I was exposed to a variety of plans/techniques.	1	2	3	4	5
My assigned area was consistently staffed with clinical personnel.	1	2	3	4	5
My clinical environment was conducive to learning (organized, efficient, resourceful).	1	2	3	4	5

Student Signature/Date: ____

Pre-Comp Assessments

Pre-comp assessments should be completed prior to attempting a competency

- Xirreg calc/Clinical set-up
- Contouring
    - How and what to contour for each anatomical site
- Photons
    - Hand calculation
    - Making a new beam
    - Different energies (6x vs. 15x)
    - Norm point placement
    - Weighting
    - Isodose lines (coverage/hot spots)
    - Spreadsheet
- Electrons
    - Hand calculation
    - Making a new beam/drawing a field
    - Different energies
    - Norm to different isodose lines/depths
    - Bolus vs. no bolus
    - Isodose lines (coverage)
    - Spreadsheet
- Single photon field
    - Placing the beam
    - Different energies
    - Calc'd to different depths
    - Why use a single field?
    - When not to use a single field
- Parallel opposed fields
    - Place beams
    - Norm point
    - Energy
    - Weighting
    - Isodose lines (cold and hot spots)
- Whole brain
    - Place beams and draw blocks
    - Norm point
    - Weighting
    - Spreadsheet

- Wedge pair
    - Place beams
    - Norm point
    - Different wedge angles (15, 30, 45, 60)
    - Isodose lines (hot spots)
    - Use of different wedges with different beam angles

Competency Checklist

	Date	Instructor Signature
Brain		
Whole Brain		
3/5-fld Brain		
Breast		
3D Tangent Breast (Fld-n-Fld)		
3D Tangent Chest Wall (Fld-n-Fld)		
4-fld Breast/Chest Wall (Tangent, SClav, IMN)		
Mini Tangent Photon Boost		
Electron Tumor Boost		
Electron Chest Wall Scar Boost		
Thorax		
AP/PA Lung with Offcords		
IMRT Lung		
Mantle		
3/4-fld Esophagus		
Abdomen		
3D Conformal (pancreas, stomach)		
IMRT Abdomen/ Esophagus		
PAN Pelvis		
Pelvis		
4-fld Pelvis		
3-fld Prone Rectum		
IMRT Prostate with Nodes		
IMRT Prostate with SVs		
Skeletal		
AP/PA Spine		
Extremity		
Electrons		
Single Fld		
Abutting Flds		
Craniospinal		
Head and Neck		
3D Head and Neck (Lats, LAN, PEB)		
IMRT Head and Neck		

Larynx		
Miscellaneous		
Wedge Pair (any anatomical site)		
Electron cut-out		

Clinical Competency Form

Student Name: ____________________________________ Date: __________________________

Treatment Site: ____________________________________

Clinical Instructor: ____________________________________ Grade: ___________________

Date reviewed with student: ____________________________________

Student signature: ____________________________________

Task	Pass	Fail	N/A	Comments
Contouring				
Treatment technique correctly applied				
Beam energy/modality/machine correct				
Norm point placement correct				
Total dose/dose per fraction/Rx isodose correct				
Beam weighting utilized appropriately				
Field blocking applied correctly				
Plan done according to direction and in a timely fashion				
Beam modifiers used where applicable (wedges/bolus/etc.)				
Imported fields/documents/images to Mosaiq correctly				
Rad Rx correct and approved in Mosaiq				
Reviewed/discuss plan with physician				
Tx calendar/QCL correct				

Comments:

____

____

____

____

____

Quality Assurance

The student participates in treatment machine and simulator quality assurance throughout the dosimetry program.

The student should understand how the test is performed, the recommended frequency of the test, and what to do if the test is out of tolerance.

Quality Assurance Procedure	Date Participated
Brachytherapy treatment machine	
CT simulator (daily or warm-up procedures)	
Siemens or Elekta linear accelerator (monthly)	
IMRT	
CyberKnife	
TomoTherapy	
IGRT	
Laser/ODI	

MD 507 Clinical Education II

Spring 2019

Course Instructors
UNC certified medical dosimetrists

Monday, Wednesday, Friday (8:00 a.m. – 4:30 p.m.)

Location: NC Cancer Hospital, Radiation Oncology, M Level

Course Description

This is the second of a three course sequence. During the three course sequence, the student will complete clinical rotations including 3D, IMRT, brachytherapy, and quality assurance. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 15 weeks in length.

Prerequisite: A grade of C or better in MD 506

Objectives:

The course is designed to do the following:

1. Introduce the student to basic clinical operations
2. Teach the student basic (3D) medical dosimetry procedures in laboratory sessions
3. Introduce the student to various quality assurance procedures
4. Introduce the student to the performance of various clinical procedures; simulations linked with treatment planning
5. Allow the student to perform under direct supervision less complex set-ups with treatment planning
6. Demonstrate an understanding of the basic clinical concepts of medical dosimetry
7. Demonstrate an understanding of theory and principles of operation of treatment planning computers
8. Demonstrate an understanding of the different types of radiation production
9. Understand and calculate radiation attenuation and decay
10. Demonstrate an understanding of the different types of radiation detectors
11. Demonstrate a basic understanding of treatment planning
12. Demonstrate an understanding of the role of a medical dosimetrist

Note: Clinical time must be recorded on a clinical time sheet with the clinical instructor's initials.

Grading and Assignments

Clinical competencies	45%
Overall evaluations	40% (at the end of each rotation)
Weekly writing assignments	10%
Self evaluations	5%

The student must complete 12 clinical competencies by the end of the semester. Competencies are graded pass/fail. To complete a clinical competency is considered to be a numerical grade of 100.

Note: All medical dosimetry calculations and treatment plans must be approved by a UNC certified medical dosimetrist prior to implementation on a treatment machine.

Clinical requirements

1. The student must participate in 8 CT simulation procedures. These should be documented in the student's log.
2. The student must observe 2 patient consults with a UNC radiation oncology medical resident. These should be documented in the student's log.
3. The student must observe 2 brachytherapy procedures. These should be documented in the student's log.
4. The student must run RayStation once during chart rounds.
5. The student must write up 5 case presentations from morning conference. This should be one page in length and describe the patient's set-up, treatment, and any special dosimetry considerations.
6. The student must attend one Wednesday morning quality assurance meeting (9:45 a.m. – 11:00 a.m. in the NC Cancer Hospital, B Level, Library). This should be documented in the student's log.

Note: These must be completed during the spring semester.

MD 508 Clinical Education III

Summer 2019

Course Instructors
UNC certified medical dosimetrists

Monday, Wednesday, Thursday, Friday (8:00 a.m. – 4:30 p.m.)

Location: NC Cancer Hospital, Radiation Oncology, M Level

Course Description

This is the third of a three course sequence. During the three course sequence, the student will complete clinical rotations including 3D, IMRT, brachytherapy, CyberKnife, and quality assurance. The length of these rotations varies. While in the clinical setting, the student will observe and work directly with a medical dosimetrist. Emphasis is given on learning and understanding the role and responsibilities of a medical dosimetrist in the clinical setting. This course is 12 weeks in length.

Prerequisite: A grade of C or better in MD 507

Objectives:

The course is designed to do the following:

1. Introduce the student to basic clinical operations
2. Teach the student basic (3D) medical dosimetry procedures in laboratory sessions
3. Introduce the student to various quality assurance procedures
4. Introduce the student to the performance of various clinical procedures; simulations linked with treatment planning
5. Allow the student to perform under direct supervision less complex set-ups with treatment planning
6. Demonstrate an understanding of the basic clinical concepts of medical dosimetry
7. Demonstrate an understanding of theory and principles of operation of treatment planning computers
8. Demonstrate an understanding of the different types of radiation production
9. Understand and calculate radiation attenuation and decay
10. Demonstrate an understanding of the different types of radiation detectors
11. Demonstrate a basic understanding of treatment planning
12. Demonstrate an understanding of the role of a medical dosimetrist

Note: Clinical time must be recorded on a clinical time sheet with the clinical instructor's initials.

Grading and Assignments

Clinical competencies	45%
Overall evaluations	50% (at the end of each rotation)
Self evaluations	5%

The student must complete all required competencies (in order to graduate) by the end of the semester. Competencies are graded pass/fail. To complete a clinical competency is considered to be a numerical grade of 100.

Note: All medical dosimetry calculations and treatment plans must be approved by a UNC certified medical dosimetrist prior to implementation on a treatment machine.

Brachytherapy Clinical Rotation

Skill	Related Concept
Preparation	
Identify site of treatment	Determine possible applicators used for specific site
Indicate radioactive source of be used	Describe the properties of sources
Identify applicators specific to case	Distinguish between applicators as they are used clinically
	Explain how applicator affects surface dose and percent depth dose and discuss shielding
	Determine appropriate treatment system for patient (Fletcher, Manchester, MIR)

Know the difference between LDR and HDR. Explain the similarities and differences between LDR and HDR with regard to applicators, quality assurance, treatment preparation, dose, planning, and paperwork.

Know the difference between manual and remote. Describe the similarities and differences between afterloading.

Skill	Related Concept
Prepare applicators for treatment	Know implication of time and type of sterilization for applicator preparation
Prepare equipment for treatment	Discuss reasons for all aspects of equipment preparation
Perform quality assurance on applicators, isotopes, and treatment machines	Analyze logbook and reports for annual applicator quality assurance and write analysis
	Write an organized report discussing the process of source quality assurance to include locating source, measuring activity, and inputting into treatment planning system
	Refer to TG-59 in evaluating treatment machine quality assurance, and analyze data, process, and results

Check in sources	Measure activity of sources and calculate the appropriate decay for the time of use
Know decay modes of radioisotopes and appropriate shielding	
Know appropriate emergency procedures in case of radioisotope spill, lost source, etc.	Evaluate each specific situation in determining appropriate action in case of emergency

Planning

Acquire localization films or proper imaging studies	Critique films for effective use in computer treatment planning with respect to ease and accuracy of dummy source identification
	Recognize when necessary to contact dosimetrist to be involved with filming or to review films
Understand process physician uses in	Determine dose through use of the prescription preparing sheet following dosimetry concepts: decay constant, half life, source strength, and build-up factors
Calculate dose around a point source	Understand the use of long and away tables and when point source approximation is valid
Perform radioactive decay calculations	
Prepare treatment form	Apply rules for treatment system (for ca cervix) – LDR
	Determine dwell positions and dwell times – HDR
Identify sources and interest points on films or on appropriate imaging studies	Explain how orthogonal film coordinates are related and determined
Know significance of course and point location	
Generate treatment plan giving dose distribution in three dimensions	Determine which views provide the most useful information to the physician

Verify input information for accuracy	Analyze treatment plan for accuracy

Treatment

Identify patient for treatment	Discuss implications of incorrect patient Identification, including NRC regulations
	Review Code of Federal Regulations, chapter 10, Parts 20 and 35, and discuss with radiation safety officer
Explain procedure to patient	Determine patient's knowledge level and explain procedure that's comprehensible to them.
Assist physician in positioning applicators	
Select and validate correct source for treatment	Differentiate among sources according to their properties
Perform treatment time calculations	Explain relationships among dose specification and prescription reference points, mg-hrs, mgRaEq-hrs, total reference air KERMA, 60 Gy reference volume dimensions
Identify various survey meters	Evaluate use of appropriate survey meter for specific situations
	Determine if meter reading is adequate
Complete paperwork, measurements, counts, and return seeds	

Brachytherapy Clinical Rotation

Preparation

Comments:

Planning

Comments:

Treatment

Comments:

Brachytherapy Clinical Rotation

Quality Assurance Project

A written report in bulleted format stating the process of applicator QA, source QA, and HDR QA is due at the end of the brachytherapy rotation. This report must also include the tolerances of acceptance, frequency, and what to do if the test is not within limits.

Clinical Instructors

Brachytherapy physicists and residents

Applicator QA

Review TG-56

Review HDR Commissioning report and radiographs

Discuss with clinical instructor

Review objectives provided by clinical instructor

State the test, what is being tested, frequency, tolerance, and how performed

Source QA

Refer to TG-56

Measure source activity and calculated decayed value

Input source parameters and verify information in treatment planning system

Determine accuracy of dose calculation

State the test, what is being tested, frequency, tolerance, and how performed

HDR Machine QA

Take part in QA including source exchange and morning QA

Refer to TG-59 and TG-56

State the test, what is being tested, frequency, tolerance, and how performed

MD 509 Radiation Safety and Protection

Fall 2018

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Friday (8:00 a.m. – 4:30 p.m.) and Monday (8:00 a.m. – 12:00 p.m.); End of first week and beginning of second week of the program

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is an introduction to the sources of radiation. It includes detection and measurement, source handling, surveys, maximum permissible doses, room design, and regulations.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Handouts are designed to guide the student through this course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test Performance	70%
Homework	30%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 509

Course Sequence

Radiation Safety

1) Concepts and units
    a) Radiation protection standards
    b) Quality factors
    c) Definitions for radiation protection
    d) Dose equivalent
        i) Units of dose equivalent
    e) Effective dose equivalent
2) Types of radiation exposure
    a) Natural background radiation
    b) Man-made radiation
    c) NCRP #91 recommendations on exposure limits
3) Protection regulations
    a) NRC definitions
        i) Recordable event
        ii) Misadministration
    b) NRC administrative requirements
        i) Radiation safety program
        ii) Radiation safety officer
        iii) Radiation safety committee
        iv) Quality management program
    c) NRC regulatory requirements

Radiation Shielding

1) Treatment room design
    a) Controlled/uncontrolled areas
    b) Types of barriers
    c) Factors in shielding calculations
        i) Workload (W)
        ii) Use factor (U)
        iii) Occupancy factor (T)
        iv) Distance
2) Shielding calculations
    a) Primary radiation barrier
    b) Scatter radiation barrier
    c) Leakage radiation barrier

   d) Neutron shielding for high energy photon and electron beams
3) Sealed source storage
4) Protection equipment and surveys
   a) Operating principles of gas-filled detectors
   b) Operating characteristics
   c) Radiation monitoring equipment
      i) Ionization chamber (cutie pie)
      ii) Geiger-Mueller counters
      iii) Neutron detectors
   d) Personnel monitoring

Treatment Planning Evaluation and Quality Assurance

1) Plan quality
   a) ICRU definitions (max dose)
   b) PTV coverage
   c) OAR evaluation
2) Deliverability
   a) Complexity
   b) Uncertainties
   c) Volatility
3) TP – quality assurance
   a) TG-53
   b) Review of images and targets
   c) Review of beam data
   d) VanDyk recommendations
   e) Data transfer
   f) TP disasters

External Beam Quality Assurance

1) Overview of quality assurance in radiation therapy
   a) Goals
   b) Staffing
      i) Roles, training, duties, and responsibilities of individuals
   c) Equipment selection and specifications
2) Linac and imaging quality assurance
   a) Acceptance testing – linac
   b) Commissioning – linac
      i) Data required
      ii) Computer commissioning
      iii) Routing quality assurance and test tolerance

      iv) Daily quality assurance
      v) Monthly quality assurance
      vi) Yearly quality assurance
   c) Quality assurance of imaging apparatus
      i) Portal imagers
      ii) Linac-mounted real-time fluoroscopy units
      iii) KVCT (cone beam) quality assurance testing
      iv) MVCT quality assurance testing (TomoTherapy)
   d) Dosimetric patient quality assurance
      i) Dosimetry based
         (1) Diodes
         (2) TLDs
         (3) MOSFETs

Calibration of Dose Output

1) Units of radiation dose, dose equivalent, and RBE dose
2) Calculation of dose from exposure
   a) Converting exposure to absorbed dose in air
   b) F-factor
   c) Dose in free space
3) Measurement of absorbed dose with an ionization chamber
   a) Stopping powers
      i) Unrestricted stopping power
      ii) Collisional stopping power (Sc)
      iii) Radiative stopping power (Sr)
      iv) Restricted stopping power
   b) Bragg-Gray cavity theory
   c) Spencer-Attix cavity theory
4) AAPM calibration protocols
   a) TG-51 protocol (photons and electrons)
   b) TG-61 protocol (superficial x-rays)

Other Measurement Systems

1) Film
   a) Radiographic
   b) Radiochromic
2) TLD
   a) Phosphorescence
   b) Thermoluminescence
3) Scintillation

4) Calorimetry
5) Gel/chemical dosimetry
6) Diode detectors

MD 510 Anatomy for Radiation Oncology

Fall 2018

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Friday (3:00 p.m. – 4:30 p.m.)

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

<u>Course Description</u>

This course teaches human anatomy with an emphasis on sectional anatomy and topography as it applies to radiation therapy. Identification of cross-sectional anatomy at different anatomical locations within the human body is also reviewed.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

<u>Required Text and Handout Materials</u>

Madden, M. *Sectional Anatomy Review*.

<u>Grading and Assignments</u>

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test Performance 100%

<u>Attendance and Special Assistance</u>

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

<u>Honor Code</u>

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 511 Radiation Oncology Pathology

Fall 20178

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Monday (12:30 p.m. – 4:30 p.m.), Tuesday (8:00 a.m. – 4:30 p.m.); second week of orientation

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is an introduction to bodily responses to injury, including neoplasia, carcinogenesis, and staging/grading of tumors.

Prerequisite: Admission to the UNC Hospitals Medical Dosimetry Program

Required Text and Handout Materials

Handouts are designed to guide the student through the course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test Performance 100%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 512 Special Topics in Radiation Oncology

Summer 2019

Course Instructor
Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Tuesday (9:30 a.m. – 12:00 p.m.) x 5 weeks

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course consists of various seminars associated with radiation oncology. Topics include treatment techniques of various cancers, technological advances in cancer treatment, cancer treatment trends, and the role of a medical dosimetrist.

Prerequisite: A grade of C or better in MD 503

Required Text and Handout Materials

Handouts are designed to guide the student through the course.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

One-page reports (x 6)	100%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 513 The Radiobiology of Radiotherapy

Spring 2019

This course covers the theories and concepts related to the molecular, cellular, tissue and organism-level effects of exposure to ionizing radiation, and how these relate to the practice of radiation therapy.

Instructor: Elaine M. Zeman, Ph.D.

Associate Professor

Department of Radiation Oncology

UNC School of Medicine

Phone: 919-843-7590

E-mail: elaine_zeman@med.unc.edu

Office: Room B127, Physicians Office Building

Hours Available: after class on Tuesdays, or Monday-Thursday afternoons with some advanced notice

Course Schedule:

Two sessions per week: Tuesdays and Thursdays, 1:00 ~ 2:00 pm

Radiation Oncology Manning Level Classroom

Textbooks:

Class handout materials are available digitally and can be obtained from a cloud-based dropbox. The instructor will e-mail the student direct links to download the handouts as they are made available.

Supplemental Reading:

Principles and Practice of Radiation Therapy, Fourth Edition by C.M. Washington and D. Leaver (Mosby, St. Louis, 2015). Sections on radiation biology and radiation protection.

Radiologic Science for Technologists: Physics, Biology and Protection, Tenth Edition by S.C. Bushong (Mosby, St. Louis, 2013). Sections on radiation protection (multiple chapters).

Radiobiology for the Radiologist, Eighth Edition by E.J. Hall and A.J. Giaccia (Lippincott, Williams & Wilkins, Philadelphia, 2018). Higher-level radiobiology textbook.

An Introduction to Radiobiology, Second Edition by A.H.W. Nias (John Wiley & Sons, Ltd., New York, 1998). Lower-level radiobiology textbook, but outdated.

Primer of Medical Radiobiology, Second Edition by E.L. Travis (Year Book Medical Publishers, Inc., Chicago, 1989). Lower-level radiobiology textbook, but *way* outdated.

Exams and Grading:

Three quizzes and a final exam will be given during the course at approximately monthly intervals, with each quiz intended to test knowledge of the material presented since the previous quiz. The final exam will also largely emphasize the most recent material presented, however will also include a few questions related to earlier parts of the course. The final exam is also "weighted" to count as the equivalent of two quizzes, and accordingly, will be a longer test.

The lowest quiz score will be dropped when calculating the final grade. (And since the final counts as two quizzes, keep in mind that if the final exam score is the lowest, only one score will be dropped.)

Exam questions will consist of multiple-choice, true-false, "fill in the blank" and "short answer/brief definition" formats. In addition, two or three problem solving, graph interpretation, and/or essay-type questions will be included on each exam.

The lowest quiz score will be dropped when calculating the final grade. (And since the final counts as two quizzes, keep in mind that if the final exam score is the lowest, only one score will be dropped.)

Exam questions will consist of multiple-choice, true-false, "fill in the blank" and "short answer/brief definition" formats. In addition, two or three problem solving, graph interpretation, and/or essay-type questions will be included on each exam.

The grading scale will be as follows:

97 and up	A+
93 – 97	A
90 – 93	A-
87 – 90	B+
83 – 87	B
80 – 83	B-
77 – 80	C+
73 – 77	C
70 – 73	C-
67 – 70	D+
63 - 67	D
Below 63	F

In order to pass the course, the student must achieve an average score (across all quizzes) of at least 70%.

Course Outline and Objectives:

Introduction; Radiation Chemistry; Free Radical Reactions

1. What is radiobiology?

2. *Cell biology review.*

3. The interaction of ionizing radiation with biological materials.

    a) sources of "background" radiation
    b) high versus low LET radiations
    c) the radiolysis of water
    d) free radical chemistry
    e) cellular targets for radiation damage
    f) direct and indirect effects of radiation
    g) radiation damage to DNA
    h) the radiochemistry of the oxygen effect

The Take Home Messages:

1. Define what radiobiology is, and how it applies to the practice of radiation oncology.

2. Know the average amount of background radiation everybody (in the US) is exposed to annually, and what the contribution is from natural versus man-made sources.

3. Describe how free radicals are formed and identify some reactions of the free radicals derived from water radiolysis.

4. Describe the effect of LET on radiation interactions at the chemical level.

5. Understand the difference between the direct and indirect effects of ionizing radiation in biological systems.
6. Know the types of DNA damage caused by ionizing radiation and how these might be related to chromosomal damage.

Cellular Response to Radiation

1. Consequences of DNA damage.

   a) enzymatic repair of damage vs. tolerance of damage
   b) human diseases related to DNA repair deficiencies
   c) chromosome aberrations

2. Fate of irradiated cells.

   a) reproductive or mitotic death
   b) interphase death or apoptosis
   c) division delay
   d) mutation
   e) neoplastic transformation and carcinogenesis

3. Cell survival curves.

   a) what is *really* meant by "cell death"?
   b) survival curve models and parameters
   c) partial response vs. complete response vs. tumor control

4. Tissue dose response curves.

   a) are cell survival curves representative of what is going on in tissues?
   b) dose response relationships for normal tissues
   c) dose response relationships for tumors

5. Cellular "repair".

   a) sublethal damage recovery (SLDR)
   d) potentially lethal damage recovery (PLDR)
   c) repair and fractionation in radiotherapy
   b) age response through the cell cycle
   e) radiation-induced cell division delay

The Take Home Messages:

1. Know the possible fates of cells that have been irradiated with ionizing radiation.

2. Be able to recognize major types of chromosome aberrations and their possible consequences to the cell.

3. Understand the function of a cell survival curve and be able to recognize, label and explain major components of the curves.

4. Estimate the relative radiosensitivities of two different cell types from their cell survival curves.

5. Know the difference between a cell survival curve and a tissue dose response curve.

6. Know the difference between a clonogenic and non-clonogenic assay of tissue dose response, and be able to give examples of each for both tumors and normal tissues.

7. Identify and explain factors that affect cellular recovery from radiation damage.

Basic Tissue Response to Radiation

1. *A review of different cell and tissue types in the human body.*

2. Laws of Bergonié and Tribondeau.

3. Cell populations and normal tissue organization before and after irradiation.

4. *Cancer biology: Why and how does cancer develop?*

5. Growth patterns of tumors before and after irradiation.

6. *Cancer statistics.*

The Take Home Messages:

1. Be able to recite the laws of Bergonié and Tribondeau, and understand how these translate into the "VIM and DIM" and "hierarchical and flexible" tissue radiosensitivity classification systems.

2. Know the definition of a "target cell", along with the types of target cells that have been identified for different normal tissues.

3. Develop a basic understanding of what genetic events cause normal cells to become cancerous, what properties or “behaviors” are characteristic of cancer cells, how tumors grow and how this is measured clinically.

4. Understand the meaning of, and difference between, cancer prevalence and prognosis; be able to identify the most prevalent cancers and their relative prognoses.

Early and Late Effects in Normal Tissues

1. Which effects are "early" and which "late"?

2. The acute, whole-body radiation syndromes.
    a) prodromal syndrome
    b) cerebro- and cardio-vascular syndrome
    c) gastrointestinal syndrome
    d) hematopoeitic syndrome

3. Radiation effects on the embryo and fetus: teratogenesis.

4. Radiation-induced cataracts.

5. Carcinogenesis as a late effect.
    a) second malignancies in radiotherapy patients
    b) radiation carcinogenesis in non-radiotherapy patients

7. Radiation protection: Terminology and exposure limits.

    a) genetic vs. somatic effects
    b) stochastic vs. non-stochastic ("deterministic")
    c) doses, dose equivalents and weighting factors
    d) cardinal rules of radiation protection
        1] ALARA
        2] GSD
        3] NIRL
    e) exposure limits for radiation workers and the general public
    f) risk and risk perception

The Take Home Messages:

1. Define the "mean lethal dose" ($LD_{50/30}$).

2. Know the approximate $LD_{50/30}$ for humans, both with and without medical intervention.

3. Describe the set of exposure conditions that would lead to a "total body" radiation syndrome.

4. Identify the clinical stages of response in the total body radiation syndrome.

5. Be able to discuss the major radiation syndromes and identify the dose ranges over which they occur.

6. Understand the effects of radiation on an embryo or fetus, the approximate dose range over which these effects occur, and the time during gestation when the embryo or fetus would be most susceptible to these effects.

7. Be able to describe the features of radiation-induced cataracts that make them unique among early and late effects.

8. Be able to describe, and give numerical risk estimates for, the relationship between radiation exposure and the induction of fatal cancer.

9. Understand what epidemiology is, and its strengths and weaknesses.

10. Be able to name some of the irradiated human populations who have been studied for evidence of elevated cancer risk.

11. Compare and contrast somatic and genetic radiation effects.

12. Understand the difference between stochastic and non-stochastic effects.

13. Be able to define the terms absorbed dose, dose equivalent, effective dose equivalent, collective dose equivalent, and genetically significant dose.

14. Know the pertinent radiation exposure limits that apply to you, your patients, and members of the general public.

Radiation Histopathology

1. What is really meant by "tissue tolerance"?

2. Rubin and Casarett, Emami and QUANTEC tables of normal tissue complications and tolerance doses.

3. Radiation histopathology in major tissues and organs.

a) bone marrow
b) reproductive organs
c) intestinal mucosa
d) skin
e) kidney
f) lung
g) liver
h) heart and vasculature
i) nervous system
j) miscellaneous

4. General guidelines for normal tissue tolerance and tumor control.

5. New directions in our understanding of tissue tolerance in radiotherapy.

    a) how early and late effects change with fractionation pattern

    b) new clinical method for scoring early and late effects in normal tissues

    c) normal tissue tolerance to re-irradiation

The Take Home Messages:

1. List the four major categories of cell populations as defined by Rubin and Casarett, and give examples of each.

2. Know what is meant by "$TD_{5/5}$" and "$TD_{50/5}$".

3. Know the different possible target cells in normal tissues, and the corresponding histological changes in the tissues caused by the loss of these cell types.

4. Be able to rank major organs by their relative radiosensitivities.

5. Be able to compare and contrast radiotherapy doses for tumor cure with those for normal tissue tolerance.

6. Develop a basic understanding of how normal tissue tolerances change with changes in dose fractionation patterns.

7. Be aware of some of the newer methods of predicting tissue tolerance and scoring tissue effects.

Radiobiology from a Clinical Perspective

1. The concept of therapeutic ratio.

2. Modification of cell and tissue response to ionizing radiation.

    a) Physical

        1] LET and RBE

        2] dose rate

        3] hyperthermia

    b) Chemical

1] radiosensitizers (including oxygen)

2] radioprotectors

3] bioreductive drugs

3. Time, dose, fractionation and isoeffect curves.
4. The problem of tumor hypoxia.
5. Radiation and chemotherapy interactions.
6. The "4 R's" of Radiotherapy".
    a) repair/radiosensitivity
    b) repopulation
    c) redistribution
    d) reoxygenation

The Take Home Messages:

1. Understand the term therapeutic ratio, and be able to express it both verbally and graphically.

2. Be able to describe the effect that changing LET has on radiation response and explain the meaning of relative biological effectiveness (RBE).

3. Account for the effect that changing radiation dose rate has on cells and tissues.

4. Explain how oxygen and other radiosensitizers increase radiation damage to cells and tissues.

5. Define the oxygen enhancement ratio (OER), sensitizer enhancement ratio (SER), and dose reduction factor (DRF), and know how to calculate these values from cell survival curves.

6. Explain how radioprotectors decrease damage to cells and tissues.

7. Rank the major cell cycle phases in terms of radiosensitivity.

8. Describe cellular repair phenomena as they relate to radiation therapy.

9. State the "4 R's of radiation therapy", and discuss each in terms of the biological effect on the tumor and normal tissues as far as radiation dose fractionation is concerned.

10. Discuss the use of chemical modifiers in radiation therapy.

11. Define NSD, and calculate NSD doses given total dose, time, and fractionation information.

12. Discuss the biological rational underlying variations in treatment techniques such as altered dose rate, hyperfractionation, accelerated fractionation, hyperthermia, use of high LET radiation, etc.

MD 514 Clinical Radiation Oncology

Spring 2019

Course Instructors:

Elaine M. Zeman, Ph.D.
Associate Professor
Department of Radiation Oncology
UNC School of Medicine
Phone: 919-843-7590
E-mail: elaine_zeman@med.unc.edu

Robert D. Adams, EdD, MPH, CMD, RT(R)(T), FAAMD
Program Director, Assistant Professor
UNC Department of Radiation Oncology, UNC School of Medicine
NC Cancer Hospital, Radiation Oncology, M Level
Phone: (984) 974-8427
E-mail: robert_adams@med.unc.edu

Thursday (9:30 a.m. – 12:00 p.m.)

Location: NC Cancer Hospital, M level, Radiation Oncology classroom

Course Description

This course is an overview of the different neoplasms in radiation oncology. The body is divided into sections for the content of this course.

This course covers the biological underpinnings, pathological and clinical characteristics, and management of benign and malignant tumors commonly treated with radiation therapy. Tumor epidemiology, presenting symptoms, diagnosis, staging, modes of spread, and survival rates are discussed.

The first section is devoted to the most common malignancies seen at UNC Radiation Oncology, and is taught by radiobiologist Dr. Elaine Zeman. As such, special emphasis is placed on the biology of the cancers, as well as cutting-edge "molecular" diagnostic methods and therapies.

The second section will cover the remaining malignant and benign tumors and will be taught primarily by the program director.

Prerequisite: A grade of C or better in MD 500 and MD 501

Required Text and Handout Materials

Washington, C & Leaver, D. *Principles and Practice of Radiation Therapy*.

Grading and Assignments

The course is graded A, B, C, D, or F. At minimum, the student must earn a grade of C to remain in the program.

Test Performance	80%
Oral Presentations	20%

Attendance and Special Assistance

Course attendance is required. Absence will not be considered a valid excuse for failure to obtain the necessary information, except under the most unusual of circumstances.

Honor Code

The principles of academic honesty, integrity, and responsible citizenship govern the performance of all academic work and student conduct. Your acceptance of enrollment presupposes a commitment to the principles embodied in the code of student conduct.

MD 514

Lecture Schedule

Section 1 CANCER BIOLOGY

Introduction and cell biology review

Normal tissue biology/cell types in various tissues

Cancer biology

Cancer phenotypes

Cancer staging and grading

Cancer epidemiology

Readings: Handout

Quiz #1 – Cell, tissue, and cancer biology

Section 2 LUNG CANCER

Introduction/epidemiology/socioeconomic impacts

Tobacco, asbestos, and other risk factors

Small cell lung cancer (SCLC)

Non small cell lung cancer (NSCLC)

Mesothelioma

Carcinoid tumors

Readings: Handout, Chapter 32, pgs. 665-681

<u>Quiz #2 – Lung cancer</u>

Section 3 HEAD AND NECK CANCER

Introduction/epidemiology/risk factors

Nasal cavity/paranasal sinuses

Nasopharynx

Oral cavity/oropharynx

Salivary glands

Salivary glands (cont.)/larynx

Larynx (cont.)/hypopharynx

Hypopharynx

Readings: Handout; Chapter 33, pgs. 693-743

<u>Quiz #3 – Head and neck cancer</u>

Section 4 FEMALE REPRODUCTIVE SYSTEM CANCERS

Introduction/epidemiology/risk factors

Cervix

Endometrium

Vagina/vulva

Ovaries

Readings: Handout, Chapter 36, pgs. 803-820, Chapter 37, pgs. 823-839

Quiz #4 – Reproductive system cancers

Section 5 BREAST CANCER

Introduction and history of breast cancer treatment

Epidemiology/risk factors/advocacy

Breast cancer types and subtypes

Breast cancer (cont., including male breast cancer)

Reading: Chapter 38, pgs. 866-892

Quiz #5 – Breast cancer

Section 6 Hodgkin's, Non Hodgkin's, Leukemias, Endocrine, CNS, GI, Male Reproductive, Pediatric, Skin, Benign, Metastatic, and Primary Bone/Soft Tissue

Readings: Respective chapters

Three oral presentations on interesting clinical cases (case studies) will be assigned and graded by the course instructors.

UNC Department of Radiation Oncology

Facilities and Equipment

The UNC Department of Radiation Oncology is located in the B and M levels of the NC Cancer Hospital. The primary didactic classroom is located within the UNC Department of Radiation Oncology. The student will train clinically in the UNC Department of Radiation Oncology as well.

1. The student is invited and encouraged to attend as many departmental functions as possible, such as the annual fall picnic and winter party.

2. Policies and procedures are posted within the department in their respective areas. All schedules, meetings, memos, etc. are posted either on the good news bulletin boards or e-mailed via the list serv.

Equipment

The UNC Department of Radiation Oncology is comprised of approximately 50,000 square feet of work space within the NC Cancer Hospital. Equipment includes three conventional linear accelerators, a TomoTherapy unit, a CyberKnife, and a brachytherapy suite. The current clinical treatment planning software is RayStation. The department is state-of-the-art and is one of only 36 recognized comprehensive cancer centers in the United States.

Faculty and Staff

1) Board-certified radiation oncologists

2) Medical residents

3) Medical physicists

4) Medical physics residents

5) Computer programmers

6) Certified medical dosimetrists

7) Medical dosimetry students

8) Registered radiation therapists

9) Radiation therapy students

10) Registered oncology nurses

11) Administrative assistants

12) Radiation and cancer biology researchers

13) Process improvement staff

14) Numerous other students

How to Apply

Application forms can be downloaded from the UNC Department of Radiation Oncology Web site (med.unc.edu/radonc/pro/education) and are also available upon require from the program director. Completed applications must be submitted no later than March 1 preceding July (fall) enrollment. Specific information required for a complete application includes:

1) Official high school transcript (if less than 5 years since graduation)
2) Official higher education transcripts (technical schools/community colleges/colleges/universities, etc.)
3) Official radiation therapy program transcript
4) Three written references using the UNC Hospitals Medical Dosimetry Program reference forms
5) Additional information as requested by program admissions

A personal interview and visit to the UNC Department of Radiation Oncology is a required part of the admissions process. April 1 is the target date for admissions decisions.

A maximum of two students may be admitted to the program each year. This may vary as program needs change.

Tuition and Fees

There is no application fee. The computer/laboratory fee of $1500 is to be paid during orientation. There are also costs for books (approximately $300), a labcoat, and other school supplies. Housing, health insurance, an official drug test, and parking are the responsibility of the student. The program does not participate in Title IV financial aid.

Transfer Students/Credits

The UNC Hospitals Medical Dosimetry Program does not accept transfer students or transfer credits. It is up to the program the student is applying for as to whether credits received during this program will be accepted at another program.

Program Physical Requirements

1. The physical activity of this position requires the student to be able to: climb, push, talk, stand, hear, walk, reach, grasp, kneel, feel, balance, pull, stoop, lift, use fingers, crawl, crouch, and perform repetitive motion.

2. The physical requirements of this position require the student be able to perform heavy work involving the exertion of up to 100 lbs. of force occasionally and/or 50 lbs. of force frequently.

3. The visual requirements, including color, depth perception, and field of vision are that the student's visual acuity is required to determine the accuracy, neatness, and thoroughness of the work assigned or to make general observations.

4. The conditions to which the student will be subject in this position include, but are not limited to: inside environmental conditions.

5. Hazards include physical conditions such as proximity to moving parts, electrical current, etc.

6. The student may be exposed to infectious diseases.

7. The student may have to interact with prisoners or mentally-challenged patients.

January 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1 New Year's Day	2 Dos Orientation	3 RT(T) Orientation	4 CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Versa2: Jourdan Dos: Ryann, Mindy	5
6	7 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	8 Class Day	9 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	10 Class Day	11 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	12
13	14 MLK DAY	15 Class Day	16 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	17 Class Day	18 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	19
20	21 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	22 Class Day	23 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	24 Class Day	25 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	26
27	28 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	29 Class Day	30 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	31 Class Day		

February 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1 Duke: Jourdan CT/Sim: Renee Versa1: Jaclyn Oncor/Tomo: Carmen Dos: Ryann, Mindy	2
3	4 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	5 Class Day	6 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	7 Class Day	8 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	9
10	11 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	12 Class Day	13 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	14 Class Day	15 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	16
17	18 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	19 Class Day	20 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	21 Class Day	22 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	23
24	25 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	26 Class Day	27 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	28 Class Day		

March 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1 Duke: Renee CT/Sim: Carmen Versa2: Jourdan Oncor/Tomo: Jaclyn Dos: Ryann, Mindy	2
3	4 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	5 Class Day	6 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	7 Class Day	8 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	9
10	11 SPRING BREAK **Emulator CE Credit Renewal**	12 SPRING BREAK	13 SPRING BREAK	14 SPRING BREAK	15 Jaclyn's Birthday SPRING BREAK	16
17	18 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	19 Class Day	20 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	21 Class Day	22 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	23
24	25 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	26 Class Day	27 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	28 Last Day of Class	29 End of Semester Clinic Make Up Day GOOD FRIDAY	30
31 EASTER SUNDAY						

April 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1 **Update Orientation Packets** Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	2 Class Day	3 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	4 Class Day	5 Duke: Jaclyn CT/Sim: Jourdan Oncor/Tomo: Renee Versa1: Carmen Dos: Ryann, Mindy	6
7	8 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	9 Class Day	10 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	11 Class Day	12 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	13
14	15 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	16 Class Day	17 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	18 Class Day	19 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	20
21	22 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	23 Class Day	24 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	25 Class Day	26 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	27
28	29 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	30 Class Day				

May 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	2 Class Day	3 Duke: Carmen CT/Sim: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	4
5	6 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	7 Class Day	8 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	9 Class Day	10 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	11
12	13 Jourdan's Birthday CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	14 Class Day	15 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	16 Class Day	17 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	18
19	20 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	21 Class Day	22 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	23 Class Day	24 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	25
26	27 Memorial Day Holiday	28 Class Day	29 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	30 Class Day	31 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	

June 2019

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	4 Class Day	5 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	6 Class Day	7 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	8
9	10 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	11 Class Day	12 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	13 Class Day	14 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	15
16	17 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	18 Class Day	19 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	20 Class Day	21 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	22
23/30	24 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	25 Last Day of Class	26 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	27 Clinic Make Up Day	28 GRADUATION	29

July 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2 RT(T) Orientation Dos: Ryann, Mindy	3 RT(T) Orientation Dos: Ryann, Mindy	4 HOLIDAY	5 Class Day 1pm: Dr. Zeman's Plagiarism Lecture	6 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	7
8	9 CT/Sim: Carmen Versa 1: Jaclyn Oncor/Tomo: Jourdan Versa 2: Renee Dos: Ryann, Mindy	10 Ryann's Birthday Class Day	11 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	12 Class Day	13 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa 2: Jaclyn Dos: Ryann, Mindy	14
15	16 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	17 Class Day	18 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	19 Class Day	20 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	21
22	23 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	24 Class Day	25 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	26 Class Day	27 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	28
29	30 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	31 Mindy's Birthday Class Day				

August 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	2 Class Day	3 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	4
5	6 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	7 Class Day	8 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	9 Class Day	10 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	11
12	13 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	14 Class Day	15 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	16 Class Day	17 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	18
19	20 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	21 Class Day	22 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	23 Class Day	24 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	25
26	27 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	28 Class Day	29 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	30 Class Day	31 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	

September 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3 HOLIDAY	4 Class Day	5 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	6 Class Day	7 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	8
9	10 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	11 Class Day	12 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	13 Class Day	14 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	15
16	17 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	18 Class Day	19 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	20 Class Day	21 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	22
23	24 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	25 Class Day	26 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	27 Class Day	28 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	29

October 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	2 Class Day	3 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	4 Class Day	5 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	6
7	8 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	9 Class Day	10 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	11 Fall Break	12 Fall Break	13
14	15 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	16 Class Day	17 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	18 Class Day	19 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	20
21 Carmen's Birthday	22 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	23 Class Day	24 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	25 Class Day	26 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	27
28	29 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	30 Class Day	31 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy			

November 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1 Class Day	2 Renee's Birthday End of Semester Clinic Make Up Day	
4	5 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	6 Class Day	7 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	8 Class Day	9 CT/Sim: Jaclyn Versa1: Jourdan Oncor/Tomo: Renee Versa2: Carmen Dos: Ryann, Mindy	10
11	12 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	13 Class Day	14 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	15 Class Day	16 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	17
18	19 Thanksgiving Break	20 Thanksgiving Break	21 Thanksgiving Break	22 Thanksgiving Break	23 Thanksgiving Break	24
25	26 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	27 Class Day	28 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	29 Class Day	30 CT/Sim: Jourdan Versa1: Renee Oncor/Tomo: Carmen Versa2: Jaclyn Dos: Ryann, Mindy	

December 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	4 Class Day	5 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	6 Class Day	7 CT/Sim: Renee Versa1: Carmen Oncor/Tomo: Jaclyn Versa2: Jourdan Dos: Ryann, Mindy	8
9	10 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	11 Class Day	12 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	13 Last Class Day	14 CT/Sim: Carmen Versa1: Jaclyn Oncor/Tomo: Jourdan Versa2: Renee Dos: Ryann, Mindy	15
16	17 Winter Break	18 Winter Break	19 Winter Break	20 Winter Break	21 Winter Break	22
23	24 Winter Break	25 Winter Break	26 Winter Break	27 Winter Break	28 Winter Break	29
30	31 Winter Break					

UNC Clinical Schedules Dos: Normal clinical hours: Monday, Wednesday, Friday 8:00 a.m. – 4:30 p.m.

Date	Student Alpha	Student Beta
July	Orientation: Introduction to Mosaiq, Immunization and Health Screening, Photo ID Badge, A3 Training, Introduction to Computer Systems, Introduction to RayStation and TP flow, Introduction to Physics in Rad Onc	Orientation: Introduction to Mosaiq, Immunization and Health Screening, Photo ID Badge, A3 Training, Introduction to Computer Systems, Introduction to RayStation and TP flow, Introduction to Physics in Rad Onc
	Orientation: Emergency Preparedness, Standard Precautions, HIPAA, Radiation Safety (+ test)	Orientation: Emergency Preparedness, Standard Precautions, HIPAA, Radiation Safety (+ test)
July 16-20	Physicians	CT/Sim
July 23-27	Personal	Physicians
July 30-August 3	CT Sim	Linacs
August 6-10	Linacs/CBLM	CBLM
August 13-17	3D	3D
August 20-24	3D	3D
August 27-31	3D	3D
September 4-7	3D	3D
September 10-14	3D	3D
September 17-21	3D	3D
September 24-28	3D	3D
October 1-5	3D	3D
October 8-10	3D	3D
October 15-19	3D	3D
October 22-26	3D	3D
October 29– Nov 2	3D	3D
November 5-9	3D	3D
November 12-16	3D	3D
Thanksgiving Week (Nov 19-23)	Eat and Sleep	Eat and Sleep
November 26-30	3D	3D

December 3-7	3D/IMRT	3D/IMRT
December 10-14	3D/IMRT	3D/IMRT
December 17-21	Winter Break	Winter Break
Dec 24-28	Winter Break	Winter Break
January 2-4	Orientation/IMRT	Orientation/IMRT
January 7-11	IMRT	IMRT
January 15-18	IMRT	IMRT
January 21-25	IMRT	IMRT
January 28 – February 1	IMRT	IMRT
February 4-8	IMRT	IMRT
February 11-15	IMRT	IMRT
February 18-22	IMRT	IMRT
February 25 – March 1	IMRT	IMRT
March 4-8	IMRT	IMRT
March 11-15	SPRING BREAK	SPRING BREAK
March 18-22	IMRT	IMRT
March 25-29	IMRT	IMRT
April 1-5	Advanced Cases	Advanced Cases
April 8-12	Advanced Cases	Advanced Cases
April 15-19	Advanced Cases	Advanced Cases
April 22-26	Advanced Cases	Advanced Cases
April29 – May 3	Advanced Cases	Advanced Cases
May 6-10	Advanced Cases	Advanced Cases
May 13-17	Advanced Cases	Advanced Cases
May 20-24	Advanced Cases	Advanced Cases
May 28-31	Advanced Cases	Advanced Cases
June 3-7	Advanced Cases	Advanced Cases
June 10-14	Advanced Cases	Advanced Cases
June 17-21	Advanced Cases	Advanced Cases
June 24-28	Advanced Cases/Graduation	Advanced Cases/Graduation

UNC HOSPITALS MEDICAL DOSIMETRY PROGRAM: RUBRIC FOR GRADING RESEARCH PAPERS

Name		Course		Assignment		Date Rcv'd		Due Date	

Item		Criterion Evaluated	Possible Points				
			Poor	Fair	Avg.	Good	Exc or N/A
1	**Introduction Section**	o Research included introductory paragraph o Intro included reason for writing paper (Background of problem) o Intro motivated reader to read the paper o Intro had an effective thesis o Intro clearly identified areas to be discussed later in the work	1	2	3	4	5
2	**Body**	o Writing was clear and concise o Discussion was understandable o Discussion was accurate o Discussion was logical o Discussion sufficiently summarized each theory o Discussion was written in 3rd person	1	2	3	4	5
3	**Conclusion**	o A conclusion was written o Conclusion summarized the findings o Conclusion written in 3rd person	1	2	3	4	5

4	**Reference Section**	o Appropriate references were used o A least 10 references were cited o All references were cited in paper o All citations in paper had corresponding reference listed o Reference page in APA format	1	2	3	4	5
5	**Style (According to AMA)**	o Paper and references double spaced o Paper written in correct font and font size o Sections of paper properly headed o Citations in text in AMA format o Quotes were formatted and cited properly	1	2	3	4	5
6	**Grammar Vocabulary Spelling Punctuation**	o Vocabulary appropriate to academic/publication level o Correct grammar used o Punctuated correctly o Spell check used	1	2	3	4	51
7	**General Construction**	o Sentence structure is correct, clear, concise and varied o Paragraphs have a topic sentence o Paragraphs have a transition sentences o Unified, coherent paragraph structure o Organized with an introduction, discussion, and conclusion/summary o Discussion was not one continuous quote	1	2	3	4	5
8	**Research Effort**	Each reference directly supports some aspect the discussion, conclusion, and summary	1	2	3	4	5

9	**Development** **Effort**	o Discussion developed with clear, concrete, and relevant support o Research met the objective of the assignment o Work demonstrates presence of critical thought and analysis o Research produced a meaningful discussion and conclusion o All work was turned in on time	1	2	3	4	5
Sub-Total Points							
Total Points (Total Point Letter Grade Conversion: **A**>4.3, **B**>3.5, **C**>2.5, **D**>2, **F**<1.5							

University of North Carolina (UNC) Hospitals
Medical Dosimetry Program

Assessment Plan: Analysis and Actions

Fall (1st semester) 2018 – Summer (3rd semester) 2019

Approved May 2017 Advisory Board

Mission Statement: The UNC Hospitals Medical Dosimetry Educational Program will competent, educated, and professional entry-level medical dosimetrists who will participate in scholarly activity and enhance overall patient care (JRCERT Standards 10.1, 3.1). .

Goal 1: Students will be clinically competent.

Outcome	Measurement Tool	Benchmark	Timeframe	Responsible Party	Results	Metrics	Action Plan
Students will demonstrate acquisition of correct dosimetry treatment planning skills.	1) Overall Evaluation Form (1,4) 2) Overall Evaluation Form (3)	1,2) At least a 4 on a 5 point scale in the 1st and 2nd semesters, and a 5 on a 5 point scale in the 3rd semester	Formative: 1st and 2nd semesters Summative: 3rd semester	Program Director (reported annually to the advisory committee)	(1,4) 2017: 4.9 2016: 4.9 2015: 4.8 2014: 4.8 2013: 4.7 2012: 4.5 2011: 4.3 (3) 2017: 4.9 2016: 4.9 2015: 4.8 2014: 4.6 2013: 4.4 2012: 4.4 2011: 4.3	100% of students have met the benchmark goal. Average scores continue to increase.	Our clinical adaptability scores continue to improve. Our clinical courses are going well, and the additional computer based learning modules have been beneficial to our students clinical education.

	3) Graduate survey (IIF)	3) At least a 4 on a 5 point scale	Annually	Program Director annually reports directly to the advisory committee	2017: 4.8 2016: 4.8 2015: 4.7 2014: 4.7 2013: 4.6 2012: 4.6 2011: 4.5 2010: 4.2	100% of students (2010-2017) met the benchmark goal. Average scores continue to increase over the last 5 years.	From 2010 until 2017 we have received 14 (2 students per class) graduate surveys. We continuously are working on program improvement, which include additional computer based learning, additional interprofessional education, and having access to a Ray Station Treatment Planning System.
	4) Employer survey (IIG,H)	4) At least a 4 on a 5 point scale	Annually		2017: 4.8 2016: 4.7 2015: 4.6 2014: 4.5 2013: 4.5 2012: 4.4 2011: 4.35 2010: 4.1	100% of students (2010-2017) met benchmark goal. Average scores have increased over the past 7 years.	Our treatment planning skillsets continue to improve. Otherwise, no explicit comments were given by employers for improvement.

Students will evidence competency in treatment.	1) Overall Evaluation Form (4) 2) Competency Evaluation	1) At least a 4 on a 5 point scale in the 1st and 2nd semesters, and a 5 on a 5 point scale in the 3rd semester 2) 5 completed competencies in the 1st semester, 10 (15 total) in the 2nd semester, (31 total) in the 3rd semester	1) Formative: 1st and 2nd semesters Summative: 3rd semester 2) 1st, 2nd, and 3rd semesters	Program Director (reported annually to the advisory committee)	2017: 4.8 2016: 4.8 2015: 4.7 2014: 4.7 2013: 4.6 2012: 4.6 2011: 4.5 2010: 4.4 2) 2017: 100% 2016: 100% 2015: 100% 2014: 100% 2013: 100% 2012: 100% 2011: 100%	100% of students met benchmark (2011-2017). Average evaluation form scores have increased; competency percentages have met minimal requirement (100%)	Our treatment planning skills continue to improve. We have worked with clinical preceptors developing new objectives for clinical rotations.
	3) Graduate survey (IC,D)	3) At least a 4 on a 5 point scale	Annually	Program Director reported annually to the advisory committee.	(IC) 2017: 4.8 2016: 4.8 2015: 4.7 2014: 4.7 2013: 4.6 2012: 4.6 (D) 2017: 4.8 2016: 4.8 2015: 4.8 2014: 4.8 2013: 4.7 2012: 4.6	100% of students met benchmark (2011-2017).	From 2011-2017, we received 10 graduate surveys. We have implemented a Ray Station Planning System to improve treatment planning skills.

	4) Employer survey (IC,D)	4) At least a 4 on a 5 point scale	Annually	Program Director reported annually to the advisory committee.	(IC) 2017: 4.8 2016: 4.8 2015: 4.8 2014: 4.8 2013: 4.7 2012: 4.6 2011: 4.5 (ID) 2017: 4.8 2016: 4.8 2015:4.8 2014 4.8 2013: 4.6 2012: 4.5 2011: 4.4	100% of students met benchmark (2011-2017)	From 2011-2017 we received 10 employer surveys. Employers were satisfied with our graduates and their level of treatment planning expertise.

Goal 2: Students will demonstrate effective communication skills.

Outcome	Measurement Tool	Benchmark	Timeframe	Responsible Party	Results	Metric	Action Plans
Students will effectively communicate with patients, medical dosimetrists, faculty, and staff.	1) Competency Evaluation (12)	1) 100% pass rate	Formative: 1st and 2nd semesters Summative: 3rd semester	Program Director (reported annually to the advisory committee)	2017: 100% 2016: 100% 2015: 100% 2014:100% 2013: 100% 2012: 100% 2011: 100%	100% of students 2011-2017, met this benchmark. Average scores have met minimal standard.	We continue to increase clinical oral skills through Socratic questions and preceptor dialogue. This is incorporated into clinical evaluations.
	2) Graduate survey (IIIK)	2) At least a 4 on a 5 point scale	Annually	Program Director (reported annually)	2017: 4.8 2016: 4.8 2015: 4.7 2014: 4.7 2013: 4.7 2012: 4.6 2011: 4.6	100% of our alumni met this benchmark from 2011-2017. Our graduates feel comfortable in their communication skills; these skills continue to improve with our graduates.	Our medical dosimetry program is unique, where our dosimetry students have daily interaction with resident and attending physicians and teaching conferences. The UNC medical dosimetry educational program interprofessional education data was peer-review published in the spring 2014 *Medical Dosimetry Journal.*

	3) Employer survey (IIIK)	3) At least a 4 on a 5 point scale	Annually	Program Director (reported annually)	2017: 4.8 2016: 4.8 2015: 4.7 2014: 4.7 2013: 4.6 2012: 4.6 2011: 4.5	100% of our alumni met this benchmark from 2010-2017 with scores increasing over the past 5 years.	This again demonstrates success to our unique medical dosimetry training program.
Students will write at a proficient level by graduation.	1) Independent Research Project Rubric	1) At least a 3 on a 5 point scale in the 1st and 2nd semesters, and a 4 on a 5 point scale in the 3rd semester	Formative: 1st and 2nd semesters Summative: 3rd semester	Program Director (reported annually to the advisory committee)	2nd semester 2017: 4.5 2016:4.5 2015: 4.3 2014: 4.2 2013: 3.9 2012: 3.8 2011. 3.4 2010: 3.2	100% of students (2011-2017) met benchmark goal. Average scores increased over the past 5 years.	Some students are stronger writers than others. Moreover, some students have been out of school longer than others. For students not as strong we do tutorials, paper examples, mentoring, and utilize UNC teaching/writing/learning resources. In 2016, our two students had three published research papers.
	2) Graduate survey (IIIK)	2) At least a 4 on a 5 point scale	Annually	Program Director (reported annually to the advisory committee)	2017: 4.7 2016: 4.7 2015: 4.6 2014: 4.6 2013: 4.6 2012: 4.5	100% of graduates attained this benchmark from 2011-2017. Average scores have	Our medical dosimetry program is unique in that almost every class has had a paper published in the academic literature. For example, in 2015 and 2016 of 4 students we had 5 profession

						increased over the past 5 years.	publications. Since the program's inception, there have been 18 published papers by our students.
	3) Employer survey (IIIK)	3) At least a 4 on a 5 point scale	Annually	Program Director (Reported annually to the advisory committee)	2017: 4.6 2016: 4.6 2015: 4.5 2014: 4.5 2013: 4.4 2012: 4.4 2011: 4.3	100% of graduates from 2011-2017 attained this benchmark. Average scores increased during the past 5 years.	This again demonstrates success to our unique training program.

Goal 3: Students will develop critical thinking skills.

Outcome	Measures	Benchmarks	Assessment Schedule	Responsible Person(s)	Results	Metrics	Action Plans
Students apply didactic concepts and information into the clinical setting.	1) Weekly Clinical Evaluation , application of knowledge section	1) Students will average at least a 3 on a 5 point scale in the 1st and 2nd semesters, and a 4 on a 5 point scale in the 3rd semester	Formative: 1st and 2nd semesters Summative: 3rd semester	Program Director (reported annually to the advisory committee)	2017: 4.7 2016: 4.7 2015: 4.7 2014: 4.7 2013: 4.6 2012: 4.5 2011: 4.1 2010: 3.8	100% of our students met this goal from 2011 until 2014. The program continues to improve in this area.	With continuous changing technologies and treatments, the program will continue to design curriculum to change with complex clinical changes. This assessment will come from our communities of interest.
	Average of actual scores of all clinical evaluations	2) At least a 4 on a 5 point scale in the 1st and 2nd semesters, and a 4.5 on a 5 scale in the 3rd semester	Formative: 1st and 2nd semesters, Summative: 3rd semesters	Program Director reported annually to the advisory committee.	2017: 4.8 2016: 4.8 2015: 4.8 2014: 4.8 2013: 4.7 2012: 4.4 2011: 4.4 2010: 4.3	100% of our students met this goal from 2010 until 2017.	Our program will continue to monitor knowledge theory with application theory coupled with knowledge transformation.

Outcome	Measurement Tool	Benchmark	Timeframe	Responsible Party	Results	Metric	Action Plans
Students will conceptualize current patient safety radiation oncology based Lean engineering principles.	1) Completion of a Lean CQI class on "good catches," A3s, and kaizens.	1) Completion of training during orientation with a passing grade and completion of a student found clinical problem utilizing an A3 tool. Evaluation is done by a Ph.D. Human Factors Engineer.	Annually	Program Director (reported annually to the advisory committee)	2017: 100% 2016: 100% 2015: 100% 2014: 100% 2013: 100% 2012: 100% 2011: 100%	Our program continues to make improvements in the quantity and quality of Lean Continuous Quality Improvement Initiatives our UNC Medical Dosimetry Students have access to in our educational program.	Our education program is unique in that patient safety is a primary emphasis of the department and chair. With this emphasis the student are trained in the most cutting edge patient safety programs in the field. This will continue to be a focus in our medical dosimetry training program.
	2) Graduate survey (IIH)	2) At least a 4 on a 5 point scale	Annually		2017: 4.9 2016: 4.9 2015: 4.9 2014: 4.9 2013: 4.7	100% of graduates attained this benchmark from 2011-	Our program is unique in that patient safety is taught at the cutting edge

					2012: 4.6 2011: 4.5	2017. Our program continues to improve in this area from 2011-2017.	level. Our graduates go into the workplace with unique continuous quality improvement skillsets.
	3) Employer survey (IIH)	3) At least a 4 on a 5 point scale	Annually		2017: 4.7 2016: 4.7 2015: 4.7 2013: 4.6 2012: 4.4 2011: 4.3	100% of alumni attained this benchmark from 2011-2017. Our program continues to improve in this area from 2011-2017.	Again, this demonstrates a unique feature that our program offers to the radiation oncology communities of interest.

Goal 4: Students will grow and develop professionally.

Outcome	Measurement Tool	Benchmark	Timeframe	Responsible Party	Results	Metrics	Action Plans
Students will demonstrate professional behaviors.	1) Overall Evaluation Form	1) At least a total 4 on a 5 point scale in the 1st and 2nd semesters, and a 5 on a 5 point scale in the 3rd semester	Formative: 1st and 2nd semesters Summative: 3rd semester	Program Director (reported annually to the advisory committee)	2017: 4.8 2016: 4.8 2015: 4.8 2014: 4.8 2013: 4.4 2012: 4.3 2011: 4.2	100% of our students attained this benchmark. We continue to demonstrate improvement in this area.	Some of our students come into the program with various perceptions of professional behavior. During both orientation and continuing throughout the academic year, professional behavior and dress are a large component of our students professional education.
	2) Graduate	2) At least a 4 on	Annually	Program	2017: 4.8	100% of our	Our alumni

	survey (IIIL)	a 5 point scale		Director (reported annually to the advisory committee)	2016: 4.7 2015: 4.7 2014: 4.6 2013: 4.5 2012: 4.3 2011: 4.1	graduates attained this benchmark. Our program continues to demonstrate improvement in this area.	understand that professional behavior and dress correlate with earning respect from patients and co-workers.
	3) Employer survey (IIIL)	3) At least a 4 on a 5 point scale	Annually	Program Director (reported annually to the advisory committee)	2017: 4.8 2016: 4.8 2015: 4.8 2014: 4.8 2013: 4.8 2012: 4.7 2011: 4.6	100% of our graduates attained this benchmark. Our program continues to demonstrate improvement in this area.	This again demonstrates success to our unique medical dosimetry educational training program.
Students will participate in continuing education.	4) Graduate survey (IVA,B,C,D)	4) At least a 4 on a 5 point scale	Annually	Program Director (reported annually to the advisory committee)	2017: 4.9 2016: 4.9 2015: 4.8 2014: 4.8 2013: 4.8 2012: 4.7 2011: 4.7	100% of our graduates attained this benchmark. Our program continues to demonstrate improvement in this area.	Program alumni were taught why continuing education is important to becoming a professional health care worker.
	5) Employer survey (IIIP)	5) At least a 4 on a 5 point scale	Annually	Program Director	2017: 4.9 2016: 4.8	100% of our graduates	This again demonstrates

				(reported annually to the advisory committee)	2015: 4.8 2014: 4.7 2013: 4.7 2012: 4.6 2011: 4.6	attained this benchmark. Our program continues to demonstrate improvement in this area.	success to our unique training program.
The student will communicate professionalism both orally and through the written word.	6) Written and oral presentations based on professional questions	6) At least a grade of 80 in the presentations	1st semester MD500, 2nd semester MD 514, 3rd semester MD 512	Dr. Adams 1st, 2nd, 3rd semesters (teaches each class)	2017: 96 2016: 96 2015: 95 2014: 94 2013: 93 2012: 93 2011: 92	100% of our graduates attained this benchmark. Our program continues to demonstrate improvement in this area.	Our program is unique in that our students interact with attending and resident physicians. Our research course is two semesters and demonstrates to the student the importance of creating knowledge from an academic perspective.