# FREE EDUCATIONAL RESOURCE: MEDICAL PHYSICS CLINICAL SKILLS WORKBOOK FOR THERAPY PHYSICS

Mary Ellen Smajo, PhD, DABR

Coordinator of Clinical Education, College of Health Professions, and Instructor and Acting Program Director, Department of Medical Radiation Physics Rosalind Franklin University of Medicine and Science, North Chicago, IL 60064, USA

**Abstract: A Medical Physics Clinical Skills Workbook for Therapy Physics was developed by Rosalind Franklin University (RFUMS) and employed as part of their clinical practicum course. The workbook is now accessible from both the AAPM website and RFUMS website. This paper describes the workbook and presents student outcome data which indicate that use of the workbook facilitated student learning.**

**Keywords: Clinical Education, Clinical Skills, Therapy Physics, Workbook.**

## INTRODUCTION

Rosalind Franklin University (RFUMS) is excited to announce the availability of its Medical Physics Clinical Skills Workbook for Therapy Physics. It may be accessed free of charge for nonprofit educational purposes via the following link: http://www.rosalindfranklin.edu/chp/MRP/ClinicalSkills Workbook.aspx

It may also be accessed from the American Association of Physicists in Medicine (AAPM) website in the "Educators Resource Guide": http://www.aapm.org/education/ERG/GRADED/ or from the Rosalind Franklin University website: under "College of Health Professions", select "Medical Radiation Physics"; under "Department Links", select "Clinical Skills Workbook".

## BACKGROUND

Rosalind Franklin University's Medical Physics Clinical Skills Workbook for Therapy Physics was initially developed as a guide for medical physics master's degree students in a clinical practicum course. Although the workbook was only partially completed at the time, the workbook and structured clinical practicum course together merited an award for "Excellence in Educational Innovation" at the 2010 AAPM national meeting in Philadelphia. [1,2] This early work was described in detail in an article in Electronic Medical Physics World,

http://www.iomp.org/sites/default/files/mp_world_vol_1_number_2.pdf [3]

Since that time, the workbook has been finalized. It is designed to serve as a companion text for any beginning medical physics student or resident who is new to the clinical setting and whose objective is to learn to safely, competently, and appropriately practice clinical medical physics.

What makes the workbook unique is that it does not tell the student how to do things. Instead it poses many questions and outlines various exercises to elucidate each topic. For true and accurate learning to occur, the student must discuss the answers to the workbook questions with a knowledgeable clinical practitioner/preceptor; this step is essential to a correct and comprehensive understanding of the material. By serving as a framework for what things should be understood and mastered in the clinical setting, the workbook's questions and exercises aid the student in learning how to think like a practicing medical physicist.

## METHODS

In order to provide comprehensive but manageable coverage of important topics in therapy physics practice, the content of the workbook was divided into modules and units. These are listed in Table 1. The topics included are based in part on the following guidance documents of the AAPM:

- AAPM Report No. 90, "Essentials and Guidelines for Hospital-Based Medical Physics Residency Training Programs, Report of the Subcommittee on Residency Training and Promotion of the Education and Training of Medical Physicists Committee of the AAPM Education Council", August 2006, [4]
- AAPM Report No. 197, "Academic Program Recommendations for Graduate Degrees in Medical Physics, Report of the Education and Training of Medical Physicists Committee", April 2009, [5] and

• AAPM Report No. 79, "Academic Program Recommendations for Graduate Degrees in Medical Physics, A Report of the Education and Training of Medical Physicists Committee", November 2002. [6]

TABLE 1: List of Modules and Units in Rosalind Franklin University's Medical Physics Clinical Skills Workbook for Therapy Physics

| |
|---|
| Module I: Basic Clinical Skills in Radiotherapy |
| Unit 1: The Clinical Environment |
| Unit 2: Simulation |
| Unit 3: Clinical Conduct |
| Unit 4: Chart Checking |
| Unit 5: Record and Verify Systems |
| Unit 6: Basic Radiation Safety |
| Module II: Quality Assurance in Radiation Oncology |
| Unit 1: Linear Accelerator Quality Assurance |
| Unit 2: Acceptance Testing and Commissioning |
| Unit 3: Measurement Equipment QA |
| Unit 4: CT Simulator QA |
| Unit 5: Portal Imaging and kV X-ray Imaging QA |
| Unit 6: Cone-beam CT QA |
| Unit 7: PET-CT QA |
| Unit 8: HDR QA |
| Unit 9: Software System QA |
| Unit 10: Prevention of Technology-Related Errors |
| Module III: Treatment Planning |
| Unit 1: Prerequisites for Treatment Planning |
| Unit 2: Mark and Start Cases |
| Unit 3: 3D-Conformal Planning |
| Unit 4: IMRT Planning |
| Unit 5: Protocols |
| Unit 6: Secondary Monitor Unit (MU) checks |
| Unit 7: Block Cutting |
| Unit 8: Diodes / TLD |
| Unit 9: Beam Data Collection, Modeling, and Commissioning |
| Module IV: Special Procedures |
| Unit 1: Radiosurgery |
| Unit 2: LDR Brachytherapy |
| Unit 3: HDR Brachytherapy |
| Unit 4: TBI Electrons and Photons |
| Unit 5: IGRT methods |
| Unit 6: Rotational Therapy |
| Unit 7: Proton Therapy |
| Module V: Health Physics |
| Unit 1: Radiation Safety |
| Unit 2: Instrumentation for Health Physics Measurements |
| Unit 3: Shielding Calculations |
| Unit 4: Isotope Procedures |

Each unit begins with a list of applicable references, although the student is instructed to supplement these by seeking out additional and updated guidance documents for each topic. Next, unit objectives summarize measurable learning goals. Most units are subdivided into tasks, consisting of various questions and exercises designed to guide the student through the topic material. For the more fundamental sections in the workbook, the student is led more methodically (e.g. analyzing in detail each step of a clinical process); as the student progresses, the questions become more open-ended and require a greater facility with clinical problem-solving skills (e.g. designing one's own form or method, which may differ from their preceptors').

The workbook's table of contents and several of the included references in the document are hyper-linked to aid the student in quickly accessing relevant material. Because the workbook was originally designed as part of a structured clinical practicum course, it contains a copy of the practicum course syllabus (as an appendix), as well as various forms for student use.

Chief among these forms is the comprehensive Clinical Competency List. This tool can be employed to track student progress through the workbook topics. At Rosalind Franklin, preceptors were asked to regularly re-assess the student's level of familiarity with each item (i.e. at the end of each academic quarter). The scores ranged from "1" ("observation only") through "4" ("competent"). In the final version of the workbook, the goal set for the medical physics master's degree students was to achieve scores of "3" ("competent with supervision") or "4" ("competent") in at least 80% of the items by graduation. No items were allowed to be left blank (a score of "0"). Certain items were designated as "core concepts": for these items, students were required to achieve a "3" or a "4". If this workbook were to be applied in the residency setting, an appropriate goal could be to expect scores of "4" ("competent") in at least 90% of the items, and "3" ("competent with supervision") for the remaining 10% of the items. In addition to quarterly competency lists, students were required to keep a composite competency list which tracked their scores over multiple quarters.

Besides completing the questions and exercises in the workbook, students were expected to document every clinical task which they observed or in which they participated by writing a thorough procedure in their own words. These documents were reviewed for accuracy and adequate detail by both the preceptor and university faculty. The optimum procedures included enough detail to allow someone unfamiliar with the process to accomplish the task. Besides giving the students practice in writing such documents, the procedures often proved helpful to the clinical staff at the various rotation sites.

Students further documented their time in the clinic by keeping detailed attendance sheets which listed their tasks each day. Preceptor-signed attendance sheets and Clinical Competency Lists have been used by students as proof of their clinical education and experience. Students were also required to gain practice in explaining medical physics topics to the clinical staff by preparing and delivering power-point presentations at their rotation sites. This often had the added advantage of providing an opportunity for radiation therapists to earn continuing education credits.

From time to time, students found themselves confronted with competency list items that could not be accomplished at their current clinical rotation site. In some cases, certain clinics did not have the equipment or simply did not perform the procedure specified by the workbook. In these cases, the students were instructed to address the topic as a "thought experiment". They were told to imagine that the lead physicist or physician had approached them and asked them to be ready to perform the procedure in a few weeks. They would need to consult guidance documents, perhaps gather information from vendors, plan how they would be ready for the procedure, decide what measurements they would make, determine how exactly they would make those measurements, and address how they would know that everything was correct and prepared for the patient's treatment. They would then be required to write up their proposed procedure and review it with their preceptor.

## EVALUATION AND DISCUSSION

Early drafts of the workbook were implemented in the medical physics clinical practicum course at Rosalind Franklin in 2008. These initial drafts included only certain sections. Over time, as the workbook became increasingly comprehensive, composite competency list scores at graduation were evaluated to assess the benefit of a workbook-based structured clinical practicum course compared with the previous "follow and learn" method.

The RFUMS Medical Radiation Physics master's degree is a two-year (7 quarter) didactic program which includes clinical practicum work in 6 of the quarters. It is important to note that the 2009 graduating class used the workbook for only three of their six clinical quarters. The 2010, 2011, and 2012 graduating classes used the workbook for all six clinical quarters. However, beginning with the 2011 class, students were told that their goal should be either "3" ("competent with supervision") or "4" ("competent"); either of these would be viewed as equally successful in terms of the graduation requirements for the master's degree.

Figures 1, 2, and 3 present histograms of the composite competency list scores for the 2009, 2010, and 2011 graduating classes. The scores are expressed as a percentage and are shown for each student. This data indicates that the students using the clinical skills workbook employed in the context of a structured practicum course (the classes of 2010 and 2011) achieved higher composite competency list scores at graduation than the students who did not have these resources for their entire clinical experience (the class of 2009).

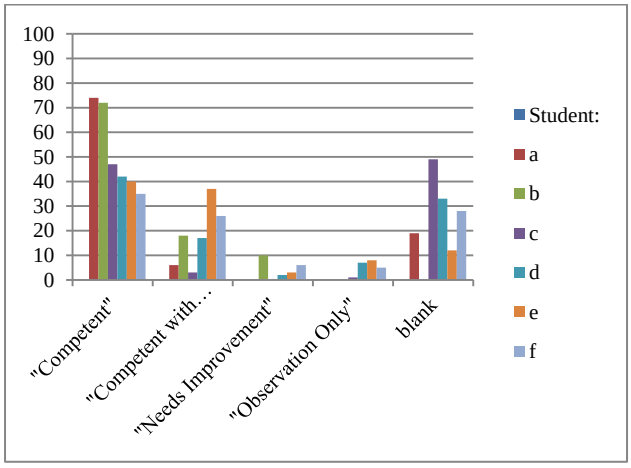


Fig. 1 Histogram Representation of Percentage Composite Competency List Scores at Graduation for 2009 Graduates: these students used the traditional "follow and learn" method for their first 3 quarters in the clinic, and used the workbook in the context of a structured clinical practicum course for their second 3 quarters in the clinic.

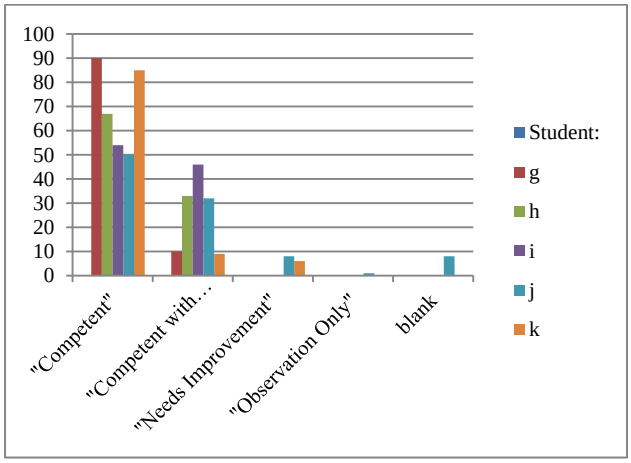


Fig. 2 Histogram Representation of Percentage Composite Competency List Scores at Graduation for 2010 Graduates: these students used the workbook in the context of a structured clinical practicum course for all 6 quarters in the clinic.

In Figure 4, because students were advised that their goal should be either "3" ("competent with supervision") or "4" ("competent"), each students' competency list scores of "3" and "4" were combined, and data for all three graduating years are shown on the same histogram. In Figure 5, the data of Figure 4 was used to calculate mean percentages of composite competency list scores at graduation for each class.

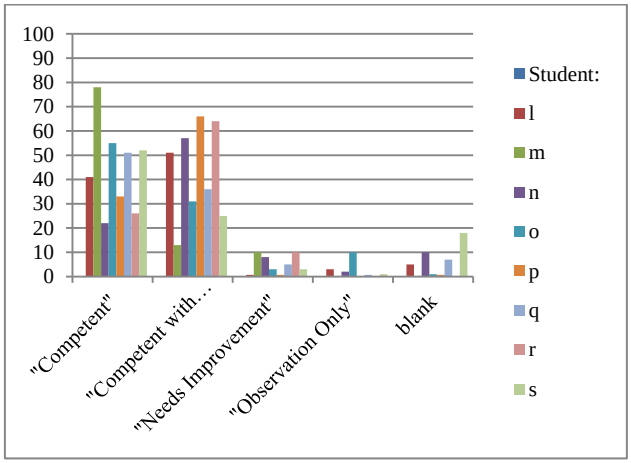


Fig. 3 Histogram Representation of Percentage Composite Competency List Scores at Graduation for 2011 Graduates: these students used the workbook in the context of a structured clinical practicum course for all 6 quarters in the clinic, but were told that their goal should be either a score of "3" ("competent with supervision") or "4" (competent") for each item in the competency list.

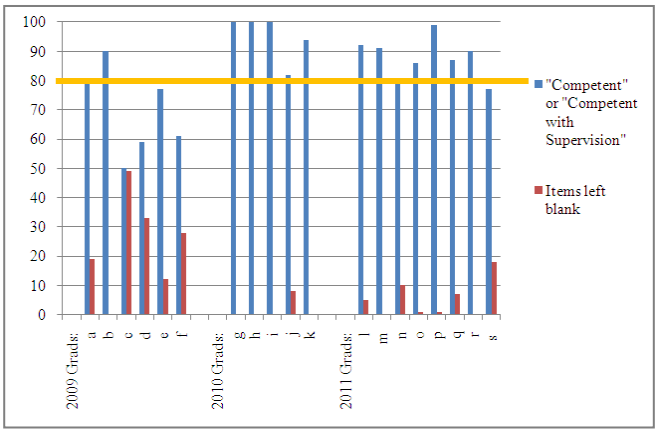


Fig. 4 Comparison of 3 Graduating Classes (2009, 2010, & 2011): Histogram representation of percentage composite competency list scores at graduation combining scores of "3" ("competent with supervision") and "4" ("competent"). The yellow line represents 80% of the items in the competency list.

In Figure 6, a mean score for each student was calculated from their composite competency list at graduation, taking into account the individual scores for all items, with each item having received a score of "4" ("competent"), "3" ("competent with supervision"), "2" ("needs improvement"), "1" ("observation only"), or "0" (blank). From this data, overall mean scores were then computed for each class. The yellow line represents an overall mean score at graduation of "3" or "competent with supervision".

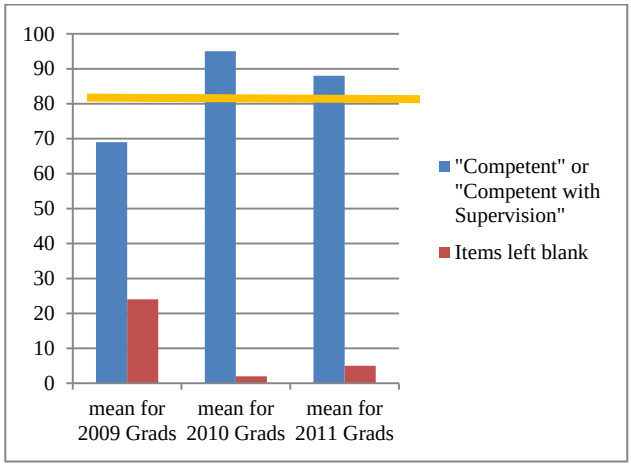


Fig. 5 Comparison of 3 Graduating Classes (2009, 2010, & 2011): Histogram representation of mean percentages of composite competency list scores at graduation calculated for each class. The yellow line represents 80% of the items in the competency list.

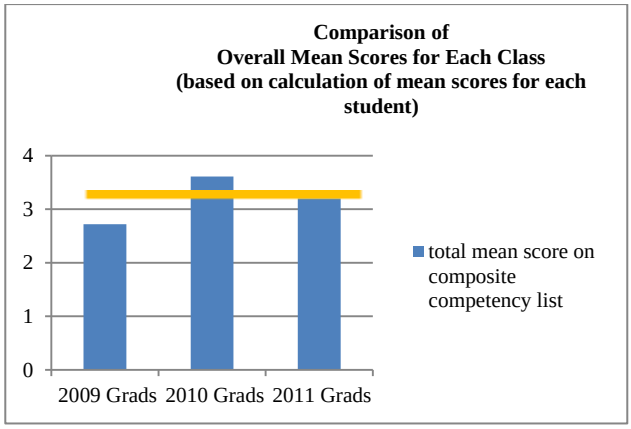


Fig. 6 Comparison of 3 Graduating Classes (2009, 2010, & 2011): For each student, a mean score was computed from their composite competency list at graduation, taking into account the individual scores for all items (each item having received a "4", "3", "2", "1" or "0"). From this data, overall mean scores were computed for each class. The yellow line represents an overall mean score at graduation of "3" or "competent with supervision".

Based in part on this data, the 2012 graduating class was required to achieve a minimum score of "3" ("competent with supervision") for at least 80% of the items in the competency list, and no items were allowed to be left blank. Also, certain items were designated as "core competencies"; these were required to be completed with a score of "3" or "4". It should be noted that the 2012 graduating students did meet all of these requirements. However, the class was deemed too small for accurate analysis of the data and hence was not included here.

In addition to examining student composite competency list scores, a per-item analysis was performed by computing the mean score for each competency list item for each graduating class. This enabled added emphasis to be given in the next year to items that did not achieve a mean score of "3" in the previous year. A per-quarter analysis of this same data for each class revealed a large variability because of the small number of students. Similarly, there was not enough data to accurately seek a correlation between competency list scores and final clinical oral exam scores. However, if more data were accrued, these analyses could prove helpful. Also, it could be insightful to aggregate and re-sort the data from each quarter by clinical site. This could allow a quantitative assessment to be made of the strengths and weaknesses of each site/preceptor combination, and hence assist in future student clinical placements.

Even though the data presented here is based on a small population (19 students total spanning 3 graduating classes), the workbook was judged sufficiently valuable to recently merit wider availability through the AAPM website (under "Medical Physics Graduate Education" in the "Educators Resource Guide", found beneath the heading "Education") and through the Rosalind Franklin University website. The workbook may be used free of charge for non-profit educational purposes. To make potential users aware of the workbook's availability, the links to the websites were sent to directors of CAMPEP-approved medical physics academic programs and residencies. It is the author's hope that the workbook will benefit many future students in various clinical settings.

## CONCLUSIONS

The Rosalind Franklin experience with the clinical skills workbook employed in the context of a structured practicum course indicates that the workbook aided master's degree students in successfully mastering tasks which comprise therapy medical physics practice. The workbook provided a framework outlining important topics and guided students in acquiring the critical reasoning and problem-solving skills necessary for the clinical setting. In addition, the workbook's competency list provided a method of assessment.

This workbook can easily serve as a companion guide for any medical physics student or resident who is working closely with a knowledgeable preceptor/mentor and who seeks to learn to safely, competently and appropriately practice clinical therapy physics.

## REFERENCES


1. M.E. Smajo, A. Markovic. One Model for Teaching Clinical Skills to Medical Physics Master's Degree Students: Employing a Clinical Skills Workbook as Part of a Structured Clinical Practicum Course. Medical Physics 37, No. 6, 3434; June 2010: http://online.medphys.org/resource/1/mphya6/v37/i6/p3434_s1?isAuthorized=no
2. American Association of Physicists in Medicine 2010 Awards Ceremony July 19, 2010 Program: http://www.aapm.org/org/history/2010AwardsCeremonyProgram.pdf
3. M.E. Smajo, A. Markovic. One Model for Teaching Clinical Skills to Medical Physics Master's Degree Students: Employing a Clinical Skills Workbook as Part of a Structured Clinical Practicum Course. Electronic Medical Physics World; December 2010, Vol. 1, No. 2: http://www.iomp.org/sites/default/files/mp_world_vol_1_number_2.pdf
4. R.G. Lane, et. al. AAPM Report No. 90, "Essentials and Guidelines for Hospital-Based Medical Physics Residency Training Programs, Report of the Subcommittee on Residency Training and Promotion of the Education and Training of Medical Physicists Committee of the AAPM Education Council", August 2006: http://www.aapm.org/meetings/documents/ResTrainingWkshpFall09/RPT_90.pdf
5. B.R. Paliwal, et. al. AAPM Report No. 197, "Academic Program Recommendations for Graduate Degrees in Medical Physics, Report of the Education and Training of Medical Physicists Committee", April 2009: http://www.aapm.org/pubs/reports/RPT_197.pdf
6. B.R. Paliwal, et. al. AAPM Report No. 79, "Academic Program Recommendations for Graduate Degrees in Medical Physics, A Report of the Education and Training of Medical Physicists Committee", November 2002:
7. http://www.aapm.org/pubs/reports/RPT_79.pdf



Corresponding author:
Author: Mary Ellen Smajo
Institute: Rosalind Franklin University of Medicine and Science
City: Chicago, IL
Country: USA
Email: maryellen.smajo@rosalindfranklin.edu