MANPOWER ISSUES FOR RADIATION ONCOLOGY

Handout for AAPM Refresher Course Session Number TU-A1-1
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The advent of managed care continues to cause a wave of change over all of medicine. Administrators are rightly concerned that radiation oncology physics services account for 30% or more of the cost of providing radiation oncology. Now or in the near future, you will be asked to defend the work you do, the staffing for your program, and the resources you consume. This confrontation is inevitable. Your quality of life and your livelihood may well depend on your response. It will come at a time when your usual source of support, the radiation oncologists, are facing major changes in their own practice and are less able to defend you. The need for an accurate and unbiased assessment of work performed by the Qualified Medical Physicist (QMP) has never been greater.

Recently, two significant studies were conducted to evaluate manpower resources for routine and special procedures in radiation oncology. In 1995, the American Association of Physicists in Medicine (AAPM) and the American College of Medical Physics (ACMP) contracted for a study of routine radiation oncology procedures with Abt Associates Inc., perhaps the nations most highly respected medical economics consulting firm. The study was published as <u>The Abt Study of Medical Physicist Work Values for Radiation Oncology Physics Services</u>. Geoffrey S. Ibbott represented the AAPM in this effort, while Michael D. Mills represented the ACMP. The full text of the study is available from either the AAPM or the ACMP, and we encourage every reader of this handout to obtain a full copy of this report. Abt Associates, Inc. is the consulting firm credited with helping the American College of Radiology develop the Radiology Resource Based Relative Value Scale (ACR-RBRVS). Medical physics work was measured according to rules defined by the American Medical Association Relative Value Update Committee (AMA/RUC) and accepted by the Health Care Financing Administration (HCFA). Thus, medical physics work was measured in the same manner as HCFA requires physicians to measure their work.

A second study was commissioned by the ACMP in 1994 with Dr. Kenneth R. Hogstrom as chairman of the ACMP Task Group named <u>New Technology Radiation Oncology Physics Manpower Study</u>. The Task Group was charged to measure the medical physicist and dosimetrist manpower effort associated with certain high-technology special procedures. This study was completed and published in 1998 in a report: <u>Survey of Physics Resources for Radiation Oncology Special Procedures</u>.

The data contained in these reports, along with some specified clinic-specific information, empower the medical physicist to calculate and defend the manpower and resource costs of radiation oncology physics services to his/her administration. Let us look at each of these studies in turn in order to asses a staffing profile for a typical community and university based program.

First, consider the Abt study. The methodology of the study involved three phases:

Phase 1 - A preliminary panel established the time periods which define medical physics work.
Panel selected an appropriate benchmark procedure (77336) from the survey codes.
Panel developed vignettes (typical clinical descriptions) for the survey codes.
Panel refined the survey instrument.

Phase 2 - One hundred Qualified Medical Physicists were surveyed. 70 returned the instruments.
Time estimates for medical physics work were surveyed for the 773XX codes.
Intensity estimates were surveyed for the codes relative to the benchmark (77336).
The service-mix (number of services performed annually) data were measured.
Staffing patterns were measured.

Phase 3 - An expert panel performed a rigorous clinical review of the total work estimates developed for the survey codes. It examined the time and intensity estimates, the work estimates, the service-mix data, and the staffing pattern data. The expert panel was composed of the following individuals:

Michael D. Mills, Project leader, ACMP	Geoffrey S. Ibbott, AAPM
Colin G. Orton, ACMP	Faiz M. Khan, AAPM
James A. Purdy, ACMP	Edwin C. McCullough, AAPM
James B. Smathers, ACMP	Alfred R. Smith, AAPM

Seventy Qualified Medical Physicists returned the surveys, yielding a response rate of 70%. The demographic and practice type profile of the respondents closely approximates that found in the AAPM and ACMP professional information surveys. The mix of different practice settings and geographic regions implies that the survey data appropriately incorporate the characteristics of various practice styles throughout the country and are not biased by responses from a single practice type or region.

The initial panel of medical physicists described medical physics work as being divided into non-procedural and procedural periods. The non-procedural period refers to the time which the QMP spends on tasks associated with the general performance quality of radiation therapy equipment: data measurement, and data validation. Non-procedural time includes each of the many specific tasks medical physicists perform to begin and maintain a radiation oncology program: designing a facility, accepting and commissioning a machine, recalibrating the machine after a catastrophic event, annual calibrations, monthly, weekly and daily checks. Both teletherapy and brachytherapy tasks are measured. This time is expended during hours when patients are not being treated. Additionally, such time is not generally associated with any specific patient. Median non-procedural times for tasks associated with groups of codes are summarized in Table 1. Times are expressed in time per year (annualized) for the most heavily utilized machine or unit in the clinic. Initial commissionings were annualized over 5 years, and expressed as time per year. Annualized total times were calculated and ordered on the individual survey level. The annualized total times are medians of this total and will not necessarily be the sum of the times listed as contributing to the total time. See Table 2 for a listing of the Procedure Descriptions.

TABLE 1

CPT Code/Type of Non-Procedural Service	**Median QMP Non-Procedural Time in Annual Hours per Machine**
77300,77305, 77310, 77315 & 77321:	
Initial Commissioning (annualized over 5 yrs)	70
Recalibration (annualized over 5 years)	28
Annual Calibrations	40
Daily, Weekly, Monthly Checks	300
Annualized total time	470
77326, 77327 & 77328	
Initial Commissioning (annualized over 5 yrs)	7
Annual Calibration and Checks	13
Annualized total time	20
77331	
Initial Commissioning (annualized over 5 yrs)	4
Monthly Checks	24
Annualized total time	29
77332 Annualized total time	1
77333 Annualized total time	1
77334	
Initial Commissioning	2
Monthly Checks	24
Annualized total time	25

The procedural period refers to the actual time the QMP spends performing each of the fourteen 773XX codes as defined in the Current Procedural Terminology (CPT). It involves services for a specific patient usually performed during normal working hours. For example, the procedural period is associated with the actual validation of a radiation dose calculation or an isodose curve plan. It is possible from the service-mix data (number of services performed on the most heavily utilized machine) to determine and apply a median non-procedural time as well as a procedural time to each of the 773XX CPT codes. These non-procedural times were allocated over the groups of CPT codes as listed in Table 1. The non-procedural time divided by the total median number of charges in the group generated (over 5 years and annualized) yields the non-procedural time associated with each CPT code. The results from this analysis are presented in Table 2. **Please note that the values in columns 3 and 4 do not sum to the values in column 5**. This is because the column 5 values are the median of the sum of the individual responses reported for columns 3 and 4. The column 5 values are considered more representative of the true time expended for these services than a simple sum of the median values in columns 3 and 4.

TABLE 2

Summary of Qualified Medical Physicist Median Times (in Hours) for Surveyed Radiation Oncology Physics Services

CPT Code	Proc. Description	Median QMP Non-Procedural Time	Median QMP Procedural Time	Total Time
77300	Basic Dos. Calc	0.38	0.17	0.63
77305	Simple Iso. Plan	0.38	0.25	0.82
77310	Intermed. Iso Plan	0.38	0.40	0.93
77315	Complex Iso. Plan	0.38	0.50	1.15
77321	Spec. Tel. Port Pln.	0.38	0.70	1.21
77326	Sim. Brachy Pln.	0.83	1.00	2.13
77327	Intermed. Bra. Pln.	0.83	1.00	2.45
77328	Complex Bra. Pln.	0.83	3.00	3.87
77331	Spec. Dosim.	1.15	1.50	2.76
77332	Sim. Treat. Device	0.01	0.10	0.11
77333	Int. Treat. Device	0.01	0.25	0.30
77334	Comp. Treat. Dev.	0.04	0.25	0.34
77336	Cont. MP Consult.	N/A*	1.50	1.50
77370	Spec. MP Consult.	N/A*	4.00	4.00

* *Non-procedural tasks associated with equipment maintenance are not applicable to CPT codes 77336 and 77370 as these are intended to be specific consultative services for specific patients.*

The time for the consultative benchmark service, CPT 77336 included all of the following tasks: Reviewing the patient case in initial presentation; performing weekly chart checks of all charting, diagnostic studies, port films and patient calculations; reviewing charts with other members of the patient management team; viewing patient positioning and machine set-up; researching treatment scheme (assuming 77370 is not billed); and performing the final chart check and validation of the treatment. Machine or program tasks are not included in these activities, so there is no non-procedural time associated with either 77336 or 77370.

It is helpful here to consider how the median medical physicist spends his procedural and non-procedural time. The median number of CPT charges billed by a Full Time Equivalent (FTE) Qualified Medical Physicist in each category was determined in the Abt survey.

Table 3

CPT Code	Med. # / Med. Phys.	Non-Procedural Time in Hours	Procedural Time in Hours
77300	600	228.0	102
77305	20	7.6	5
77310	41	25.6	16.4
77315	190	72.2	95
77321	5	4.2	3.5
77326	5	4.2	5.0
77327	5	4.2	5.0
77328	12	10.0	36.0
77331	18	20.7	27
77332	41	0.4	4.1
77333	50	0.5	12.5
77334	337	13.5	84.3
77336	1375	0	2062.5
77370	22	0	88
	Total Time:	391.1	2546.3

If the above analysis is performed taking into account the Median QMP Total Time in Table 2, the median Qualified Medical Physicist is found to work 3061.2 hours per year on routine clinical work. While the sum of the two columns above is 2937.4 hours, the Median QMP Total Time is considered the better estimate. These tasks do not take into account the additional hours required to perform new technology radiation oncology procedures such as HDR, TBI, IORT, 3-D Treatment Planning, Total Skin Irradiation, Stereotactic Radiosurgery, Stereotactic Brachytherapy and Arc Electron Therapy, etc. Time spent teaching, preparing to teach or performing clinical research is not included. The overall median Qualified Medical Physicist works with one other medical physicist, three radiation oncologists, and one and one-half dosimetrists. This team is responsible for 800 patients/year, or 635 new patients/year.

Procedural time (associated with a specific patient) was measured separately from non-procedural time (associated with equipment performance and quality assurance). Median total times for each of the 773XX CPT codes were reported to indicate how the QMP spends his/her time. However, another concept - intensity - is required to describe completely QMP work and generate associated work units or values.

Intensity estimates were obtained from the survey using the "magnitude estimation" technique. This technique involves the selection of a representative benchmark service which serves as a reference point against which the intensity of all other services in question is gauged. The benchmark should be a service which is commonly provided, is performed in a consistent manner, and has a mid-range level of work in comparison to the other services. The service 77336 was chosen and assigned an intensity of 1.00 to simplify the rating exercise. Thus, if service X was considered to be one-half the intensity of benchmark service 77336, then an intensity rating of 0.50 was reported for service X. The value assigned to each service in this manner was a "magnitude estimate" of the intensity of the service in comparison to the benchmark. Respondents were asked to consider the average intensity over the entire service, recognizing that it was likely to vary from minute-to-minute. As with the procedural time estimates, respondents were asked to base their intensity estimates on a typical patient defined in a "vignette" (representative clinical service description).

Table 4

Median Relative Intensity Estimates for Surveyed Radiation Oncology Physics Services (Increasing Order of Intensity)

CPT Code	Procedure Description	Median Relative Intensity Estimate
77332	Simple Treatment Device	0.50
77300	Basic Dosimetry Calculation	0.50
77336	Continuing M.P. Consultation	1.00*
77305	Simple Isodose Plan	1.00
77333	Intermediate Treatment Device	1.00
77334	Complex Treatment Device	1.23
77310	Intermediate Isodose Plan	1.30
77326	Simple Brachy. Isodose Plan	1.50
77321	Special Teletherapy Port Plan	1.50
77315	Complex Isodose Plan	1.55
77327	Intermed. Brachy. Isodose Plan	1.95
77331	Special Dosimetry	2.00
77328	Complex Brachy. Isodose Plan	3.00
77370	Special M.P. Consultation	3.10

* *CPT code 77336 was selected as the benchmark service for the survey; therefore, it was assigned an intensity of 1.00. The intensities of all other services were rated relative to it.*

The relative intensity estimates obtained from the survey, based on magnitude estimation techniques, are listed in Table 4 along with the median total time estimates. The 14 medical physics codes have been sorted by increasing order of intensity in Table 4 to demonstrate the progression from the least intense to the most intense services, as determined by the survey results. The data suggest that CPT codes 77332 (simple treatment device) and 77300 (basic dosimetry calculation) have the same intensity rating, which is the lowest of all of the medical physics services. The simple isodose plan (CPT 77305) and the intermediate treatment device (CPT 77333) were considered to have the same intensity as the benchmark (CPT 77336 - continuing medical physics consultation). As expected, the intermediate isodose plan has a slightly greater intensity than the simple isodose plan. Similarly, the intensity of the complex treatment device is higher than that of the intermediate treatment device. The simple brachytherapy isodose plan, special teletherapy port plan, and complex isodose plan were all assessed to be one and one-half times more intense than the benchmark. The most intense services are the intermediate brachytherapy isodose plan, special dosimetry, complex brachytherapy isodose plan and special medical physics consultation. The intensity of the former two services is nearly twice the intensity of the benchmark, while the latter two are approximately three times more intense. As described above, CPT code 77370 (special medical physics consultation) is performed in special cases, such as when the patient has had prior treatment; thus, the QMP is under added pressure to extend his/her skills to design an alternative treatment approach. Similarly, the large number of sources used in the complex brachytherapy isodose plan require completion and verification of a series of very complicated and difficult calculations which increase the intensity of this service.

The Abt study applied the standard model of work, which underlies the physician relative value units on the Medicare Fee Schedule, to the analysis of QMP work. Based on this model, QMP work was examined in terms of the time and intensity associated with providing each of the services in the 773XX series. Physician work has been defined as being comprised of four dimensions: 1) the time it takes to perform the service; 2)mental effort and judgment; 3) technical skill and physical effort; and 4) psychological stress associated with concerns about risks of complications and iatrogenic harm. The latter three components constitute what is often referred to as the "intensity", or complexity, of the service.

Therefore, work consists of time and intensity. This definition of work was adopted to develop the original resource-based relative value scale for physician work and continues to be used by the American Medical Association Relative Value Update Committee (AMA/RUC) to revise the work values assigned to physician services. Abt applied these same concepts of work to its analysis of the QMP work associated with the 14 radiation oncology physics codes defined in the CPT.

The formula for estimating the work of the QMP was determined based on the standard model for calculating physician work and the definitions, described above for the intensity and the time periods associated with QMP work. The conventional method for computing physician work is to multiply the total time of a service by its intensity. Therefore, the formula for calculating QMP work is as follows:

QMP Work (W) = Time (T) * Intensity (I)

where

Time = sum of non-procedural and procedural time.

Intensity = a single magnitude estimate of the mental effort and judgment, technical skill and physical effort, and psychological stress associated with the service.

Table 5

QMP Work Estimates for Surveyed Radiation Oncology Physics Services

CPT Code	Procedure Description	Median Survey Work Estimate
77300	Basic Dosimetry Calculation	0.33
77305	Simple Isodose Plan	0.75
77310	Intermediate Isodose Plan	1.24
77315	Complex Isodose Plan	1.69
77321	Special Teletherapy Port Plan	1.81
77326	Simple Brachy Isodose Plan	3.18
77327	Intermediate Brachy Isodose Plan	4.73
77328	Complex Brachy Isodose Plan	11.67
77331	Special Dosimetry	4.35
77332	Simple Treatment Device	0.06
77333	Intermediate Treatment Device	0.31
77334	Complex Treatment Device	0.39
77336	Continuing Med Phys Service	1.50
77370	Special Med Phys Consultation	15.00

The intensity estimates (relative to the benchmark) were applied to the total time for each service to determine the relative work values for the 773XX series of CPT codes. This calculation was performed *at the individual survey level* for each medical physics service. Please note that the product of the median total time and intensity estimates do not result in the work values reported in Table 5. This is a consequence of performing this calculation for each response and determining the median of these responses. This method is considered the most appropriate measure of the work of the typical QMP. The expert panel performed a rigorous review of the work values and validated these numbers for clinical accuracy. Work units are used by governmental agencies and mixed governmental-private sector committees to set the appropriate level of reimbursement for various CPT codes. Our participation in this study helps to defend QMP work to such groups.

Several medical physicists have requested that the work of dosimetrists and other support staff be included in this article. The Abt study surveyed both QMP time and the time estimates for support staff (dosimetrists, physics technologists, etc.) associated with the 773XX codes. This was done to assure respondents did not include time for support staff in their QMP procedural time estimates. Median procedural time estimated for support staff for each code is reported in Table 6.

Table 6

Procedural Support Time Estimates Per Surveyed Medical Physics Service (in Hours)

CPT Code	Procedure Description	Median Survey Work Estimate
77300	Basic Dosimetry Calculation	0.25
77305	Simple Isodose Plan	1.00
77310	Intermediate Isodose Plan	1.30
77315	Complex Isodose Plan	2.00
77321	Special Teletherapy Port Plan	2.00
77326	Simple Brachy Isodose Plan	1.00
77327	Intermediate Brachy Isodose Plan	1.50
77328	Complex Brachy Isodose Plan	2.00
77331	Special Dosimetry	1.00
77332	Simple Treatment Device	0.40
77333	Intermediate Treatment Device	0.75
77334	Complex Treatment Device	1.20
77336	Continuing Med Phys Service	N/A
77370	Special Med Phys Consultation	N/A

The American College of Medical Physics (ACMP) Task Group on New Technology Radiation Oncology Physics Manpower Study was formally established by Stephen W. Nagy, Ph.D., Chairman, ACMP Executive Committee, by means of his March 14, 1994 letter to Kenneth Hogstrom, Ph.D., who agreed to chair the Task Group. The purpose of the Task Group was "to identify and quantify the physics involvement and efforts associated with recent high-technology radiation oncology treatment modalities…" The Task Group identified the following special procedures for study: High-Dose-Rate (HDR) Remote Afterloading Brachytherapy, Linear-Accelerator-Based Stereotactic Radiosurgery, Electron-Arc Irradiation, Three-Dimensional Treatment Planning (External Beam), Total-Skin Electron Irradiation, Total-Body Irradiation, Stereotactic Brachytherapy, and Intraoperative Radiation Therapy. Specifically the Task Group's Charge was to:

1. Individually identify and describe selected new high technology radiation oncology treatment modalities with respect to physics involvement
2. Design and conduct a survey or study to quantify the physics efforts with respect to some standard procedure for normalization (e.g. RBRVS)
3. Document the results in a manner that will prove useful for physics manpower justification and reimbursement purposes

The methodology of the survey included the following parameters:

1. The survey was designed to yield cost (in dollars) and effort (in hours) for each of the eight procedures listed above. Physics costs were defined as the cost of all effort, equipment and maintenance/operations necessary for a procedure, including the effort of support personnel under the direction of the medical physicist (e.g., dosimetrists and radiological physics technologists).
2. Patient loads were estimated over 7 years to minimize annual fluctuations that resulted from infrequency of the procedure. Equipment cost includes capital cost and cost of 7 years of maintenance. Physics equipment was distinguished from clinical equipment in this survey.
3. Commissioning effort was allocated over 7 years, quality assurance and calibration was measured in hours/year or hours/week, and specific patient procedures were measured as hours/patient.

4. The survey was sent to those centers that were participating in national interinstitutional protocol studies in which one of five (of the eight) radiation oncology special procedures were being utilized for treatment. This list was obtained from the American Association of Physicists in Medicine (AAPM) Radiological Physics Center (located at the University of Texas M.D. Anderson Cancer Center). 109 institutions responded out of 265 that were mailed.
5. In estimating personnel costs, the medical physicist cost was assumed to be $75/h and the dosimetrist/technologist cost was $30/h. In estimating equipment cost per patient, the equipment was assumed to have a 7 year lifetime.
6. Members of the Task Group and primary responsibilities were assigned as follows: Kenneth R. Hogstrom, Chairman (Total Skin Electron Irradiation and Electron-Arc Therapy), John L. Horton (High-Dose-Rate Remote Afterloading Brachytherapy and Linear-Accelerator-Based Stereotactic Radiosurgery), Michael D. Mills (Total Body Irradiation and Intraoperative Radiotherapy), Colon Orton (Stereotactic Brachytherapy), and Gerald Kutcher (Three-Dimensional Treatment Planning-External Beam). Other members of the Task Group included Yakov M. Pipman, Lawrence W. Berkley (AAPM Liaison), and James A. Deye (ACR Liaison).
7. The results of this work are intended for use by the leadership team, the medical physicist, radiation oncologist, and administrator. The leadership team should recognize that there is a wide spread in the data for many of the special procedures, which results from existing constraints, quality of treatment delivered, and experience of the medical physicist. The leadership team should allot appropriate resources for commissioning the special procedure.

For additional details of the methodology, the reader in encouraged to review the Survey of Physics Resources for Radiation Oncology Special Procedures, available from the American College of Medical Physics. Some results of the survey are tabulated below in Table 7.

Table 7

Summary of Equipment and Physics and Dosimetry Costs for the Special Procedures

1. Total-Skin Electron Irradiation		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$2,215	$14,504 +/- $6,026
Physics equipment ($)	$950	$3,885 +/- $1,083
Commissioning Effort MP (h)	105	194 +/- 45
Ongoing Effort		
Medical physicist (h/patient)	9	18 +/- 4
Dosimetrist/Technologist (h/pat.)	5	11 +/-3
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$2,368	$2,796 +/- $441
Patient-weighted mean ($/patient)		$2,079

2. High-Dose-Rate Remote Afterloading Brachytherapy		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$480,980	$446,832 +/- $21,549
Physics equipment ($)	$12,100	$21,783 +/- $3,034
Commissioning Effort MP (h)	170	331 +/- 52
Ongoing Effort		
Medical physicist (h/patient)	8	11 +/- 1
Dosimetrist/Technologist (h/pat.)	2	3 +/- 0
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$863	$1,069 +/- $95
Patient-weighted mean ($/patient)		$879

3. Total-Body Irradiation		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$2,500	$11,512 +/- $5,265
Physics equipment ($)	$1,250	$9,177 +/- $2,564
Commissioning Effort MP (h)	85	161 +/- 29
Ongoing Effort		
Medical physicist (h/patient)	9	18 +/- 9
Dosimetrist/Technologist (h/pat.)	3	6 +/- 1
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$1,062	$2,341 +/- $1,167
Patient-weighted mean ($/patient)		$772

4. Linear-Accelerator-Based Stereotactic Radiosurgery		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$285,170	$281,170 +/- $31,330
Physics equipment ($)	$5,000	$19,047 +/- $5,488
Commissioning Effort MP (h)	200	345 +/- 51
Ongoing Effort		
Medical physicist (h/patient)	11	13 +/- 1
Dosimetrist/Technologist (h/pat.)	3	5 +/- 1
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$1,277	$1,646 +/- $209
Patient-weighted mean ($/patient)		$1,168

5. Intraoperative Radiation Therapy		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$9,400	$290,707 +/- $174,356
Physics equipment ($)	$6,000	$7,104 +/- $2,107
Commissioning Effort MP (h)	225	399 +/- 147
Ongoing Effort		
Medical physicist (h/patient)	6	15 +/- 7
Dosimetrist/Technologist (h/pat.)	1	7 +/- 7
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$767	$1,830 +/- $785
Patient-weighted mean ($/patient)		$786

6. Electron-Arc Irradiation		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$22,500	$16,970 +/- $5,750
Physics equipment ($)	$0	$2,689 +/- $1,585
Commissioning Effort MP (h)	200	413 +/- 158
Ongoing Effort		
Medical physicist (h/patient)	12	13 +/- 3
Dosimetrist/Technologist (h/pat.)	9	14 +/- 6
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$3,278	$4,144 +/- $1,078
Patient-weighted mean ($/patient)		$2,407

7. Stereotactic Brachytherapy		
Start-up Costs and Effort	**Median**	**Mean**
Radiotherapy equipment ($)	$27,500	$34,958 +/- $9,285
Physics equipment ($)	$0	$1,558 +/- $907
Commissioning Effort MP (h)	100	176 +/- 52
Ongoing Effort		
Medical physicist (h/patient)	15	17 +/- 2
Dosimetrist/Technologist (h/pat.)	3	3 +/- 1
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$1,744	$1,981 +/- 376
Patient-weighted mean ($/patient)		$1,300

8. Three-Dimensional Treatment Planning (External Beam)		
Start-up Costs and Effort	**Median**	**Mean**
Physics equipment ($)	$380,625	$483,770 +/- $94,161
Commissioning Effort MP (h)	425	1050 +/- 379
Ongoing Effort		
Medical physicist (h/plan)	5.1	8.5 +/- 2.0
Dosimetrist/Technologist (h/plan)	7.1	8.9 +/- 2.0
Plans per Patient	1.37	1.57 +/- 0.2
Total Costs, Equipment & Effort		
Institutional Distribution ($/patient)	$1,562	$3,271 +/- $776
Patient-weighted mean ($/patient)		$1,035

Historically, physics and dosimetry workload has been justified using information tabulated by *Radiation Oncology in Integrated Cancer Management*, the “Blue Book” published by Inter-Society Council for Radiation Oncology. While helpful, these recommendations were based on panel consensus rather than measured data. With the recent significant increase in new external beam and brachytherapy special procedures, the “Blue Book: staffing recommendations have been criticized an insufficiently specific to evaluate truly the physics and dosimetry needs of a progressive radiation oncology clinic. The following analysis uses the The Abt Study of Medical Physicist Work Values for Radiation Oncology Physics Services as well as the Survey of Physics Resources for Radiation Oncology Special Procedures to estimate and justify physics workload in a community radiation oncology center as well as a university based clinic. Physics and physics staff workload are evaluated on a per service bases. Routine services are evaluated separately from special procedures. The service mix allows calculation of staffing resources needed to capture all requested services and associated revenue.

It is critical that some mechanism be established to capture the hours associated with work which is performed but cannot be billed to the patient. Such work includes plans which are performed, but not used in the patient’s treatment, additional dosimetry due to equipment changes, additional effort for protocol patients and work such as final checks performed to complete documentation after the patient has completed treatment. Most of the increased effort falls on the shoulders of the dosimetrists and other physics staff. It is not unusual to find 33% or more of the work performed cannot be billed to the patient. One way to address the problem is to establish a set of “no-charge” codes which document the work has been performed, but adds no additional charge to the patient’s bill. In the following analysis, the number of hours/service for dosimetrists and other physics staff has been increased by 33% to account for the additional effort.

Consider the case of a community radiation oncology treating 800 new patients per year, approximately 635 new patients per year. An advanced community radiation oncology clinic might offer the following special procedures, as these are the most commonly available: three-dimensional treatment planning (3DT), linear accelerator based stereotactic radiosurgery (STR), High-Dose-Rate afterloading

(HDR), and Total Body Irradiation (TBI). Staffing recommendations ("Blue Book") and measured median survey data (Abt Associates) are tabulated below:

	1991 CROS Blue Book (panel derived)	1995 Abt Associates Survey (measured by survey)
Medical Physicists	2.0	2.0
Dosimetrists	2.7	1.2

However, each of the above special procedures were offered by fewer than 50% of the institutions served by the responding physicists at the time of the survey. Annual effort in hours is calculated using the hours/service for medical physicists and dosimetrists from Tables 2 and 6 above, adjusting the dosimetrist time for the number of services performed but not billed. A complete manpower analysis for this clinic addresses the routine and special procedures separately as follows:

Table 8

Medical Physicist and Dosimetrist Hours for a Community Clinic Treating 800 Patients per Year - Routine Procedures

CPT Code	Med. # / 800 Patients	Medical Physicist	Dosimetrist
	Per Year	**Annual Time**	**Annual Time X 1.33**
77300	1200	756	400
77305	40	33	53
77310	82	76	142
77315	380	437	1,013
77321	10	12	27
77326	10	21	13
77327	10	25	20
77328	24	93	64
77331	36	99	48
77332	82	9	44
77333	100	30	100
77334	674	229	1078
77336	2750	4,125	
77370	44	176	
	Total Time:	6,121	3002

Special Procedures can be subjected to the following analysis, assuming the commissioning time is annualized for the procedures. The number of patients per year is the average number reported by institutions in the report. Hours per patient is median time for medical physicist and dosimetrist reported in Table 8 above. Commissioning time is divided by 7 years and added to the maintenance time, total time is adjusted for the total number of patients treated in a year.

Table 9

Medical Physicist and Dosimetrist Hours for a Community Clinic Treating 800 Patients per Year - Special Procedures

Special Procedure	# Patients per Year (Average)	Hours/Patient Med Physicist	Hours/Patient Dosimetrist	Comm Hrs/7 + H/Year MP	Hours/Year Dosimetrist
3DT	133	7	10	61+931= 992	1330
STR	27	11	3	29+297= 326	81
HDR	58	8	2	24+464= 488	116
TBI	26	9	3	12+234= 246	78
			Total Time:	2,052	1,605

Total effort for medical physics support for routine and special procedures is 8,173 hours while dosimetry support totals 4,607 hours. This analysis justifies 3 medical physics positions and 2 dosimetry positions for this clinic. Needed physics support for a community clinic providing this limited range of special procedures is greater than that suggested by the "Blue Book" or measured in the Abt report. As special procedures are implemented in community clinics, it is important that this type of analysis be communicated to the manager to defend physics positions.

A similar analysis may be applied for the case of a University Medical School facility. Let us assume a patient load of 1600 patients per year, with a total range of special procedures offered at a frequency twice that of the institutional average. For this clinic, total-skin electron irradiation (TSE), intraoperative radiation therapy (IORT), electron-arc irradiation (EAI), and stereotactic brachytherapy (STB) are offered as special services. Staffing recommendations ("Blue Book") and measured median survey data (Abt Associates) are tabulated below:

	1991 CROS Blue Book (panel derived)	1995 Abt Associates Survey (measured by survey)
Medical Physicists	4.0	5.8
Dosimetrists	5.3	5.8

Routine and special procedures might be analyzed as follows:

Table 10

Medical Physicist and Dosimetrist Hours for a University Clinic Treating 1600 Patients per Year - Routine Procedures

CPT Code	Med # / 1600 Patients Per Year	Medical Physicist Annual Time	Dosimetrist Annual Time X 1.33
77300	2400	1512	800
77305	80	66	106
77310	164	152	284
77315	760	874	2026
77321	20	24	54
77326	20	42	26
77327	20	50	40
77328	48	186	128
77331	72	198	96
77332	164	18	88
77333	200	60	200
77334	1348	458	2156
77336	5500	8250	
77370	88	352	
	Total Time:	12,242	6004

Table 11

Medical Physicist and Dosimetrist Hours for a University Clinic Treating 1600 Patients per Year - Special Procedures

Special Procedure	# Patients per Year (Average)	Hours/Patient Med Physicist	Hours/Patient Dosimetrist	Comm Hrs/7 + H/Year MP	Hours/Year Dosimetrist
TSE	8	9	5	15+72= 87	40
IORT	38	6	1	32+228= 260	38
EAI	8	12	9	29+96= 125	72
STB	10	15	3	14+150= 164	30
3DT	266	7	10	61+1862= 1923	2660
STR	54	11	3	29+594= 623	162
HDR	116	8	2	24+928= 952	232
TBI	52	9	3	12+468= 480	156
			Total Time:	4,614	3,390

Total effort for medical physics support for routine and special procedures is 16,856 hours while dosimetry support totals 9,394 hours. This analysis justifies 5-6 medical physics positions and 4-5 dosimetry positions for this university based clinic, roughly comparable with the numbers measured in the Abt survey.

Conclusion:

The ISCRO Blue Book underestimates the physics manpower required to provide special procedure services, although dosimetrist manpower is estimated approximately correctly. The Abt survey completed in 1995 offers a snapshot of staffing at a time when special procedures were offered primarily in the medical school or university based clinics. Manpower to provide special services based on the procedure analysis above is consistent with staffing at university clinics as measured by the Abt survey. **However both the ISCRO Blue Book and the Abt survey underestimate physics staffing required if a community based clinic offers a range of special procedure services.**

This type of analysis combined with a revenue breakdown for the services provided should empower the radiation oncology manager to defend appropriate staffing for physics and dosimetry services. If staffing does not meet these levels, it may not be possible to provide a full range of special procedures or to provide the number of services requested for routine procedures. Under these circumstances, quality of patient care, revenue and profitability each may suffer.

References:

Abt 1995 — The Abt Study of Medical Physicist Work Values for Radiation Oncology Physics Services

ACMP 1998 — American College of Medical Physics Survey of Physics Resources for Radiation Oncology Special Procedures

ISCRO 1991 — Radiation Oncology in Integrated Cancer Management Report of the Inter-Society Council for Radiation Oncology