Petition to State Health Coordinating Council

Adjustment to the Linear Accelerator Need Included in the Proposed 2024 State Medical Facilities Plan

July 26, 2023 (Raleigh, NC Public Hearing)

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Statement of Requested Change

FirstHealth requests a need determination for one additional linear accelerator in Service Area 17 in the *2024 State Medical Facilities Plan* ("*SMFP*").

Background

The FirstHealth Cancer Center is one of the most complete cancer care programs in North Carolina. FirstHealth's cancer experts have the specialized knowledge and skill to diagnose and effectively treat a wide range of cancers. Through FirstHealth's affiliation with the nation's leading cancer research centers, FirstHealth physicians can offer patients the most promising and powerful new treatments. Unfortunately, with only two linear accelerators and a growing patient population, FirstHealth is severely constrained in its ability to serve patients in a timely manner during one of the most significant life events. FirstHealth has experienced a 7.0% increase in new radiation oncology patients since 2022 and a 19.0% increase in new radiation oncology therapy patients since 2021.

Reasons for the Proposed Change

FirstHealth is submitting this petition to the State Health Coordinating Council requesting an adjustment to the need determination for linear accelerators in Service Area 17. Chapter 15 of the *Proposed 2024 SMFP* identifies a surplus of 1.28 linear accelerators for Service Area 17, which includes Hoke, Lee, Moore, Montgomery, Richmond, and Scotland counties. (Attachment 1)

Table 15C-5: Linear Accelerator Service Areas and Calculations

Service Area	2023 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2021-2022 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	144,685	2	72,343	15.69%	3,339	1,670	-1.51	
Area 2	440,212	8	55,027	27.38%	33,093	4,137	-3.10	
Area 3	98,197	1	98,197	14.06%	2,336	2,336	-0.65	
Area 4	171,237	3	57,079	11.25%	11,251	3,750	-1.33	
Area 5	369,403	6	61,567	17.67%	21,492	3,582	-2.82	
Area 6	501,349	5	100,270	10.10%	31,413	6,283	-0.35	
Area 7	1,433,456	12	119,455	22.00%	76,757	6,396	-0.63	
Area 8	350,759	4	87,690	28.57%	20,341	5,085	-0.99	
Area 9	303,520	4	75,880	25.30%	16,615	4,154	-1.54	
Area 10	662,900	10	66,290	36.73%	33,830	3,383	-4.99	
Area 11*	173,876	1	173,876	20.57%	3,181	3,181	-0.53	
Area 12	638,925	7	91,275	20.23%	42,949	6,136	-0.64	
Area 13*	146,470	1	146,470	13.70%	3,884	3,884	-0.42	
Area 14**	230,834	6	38,472	74.69%	39,067	6,511	-0.21	
Area 15	201,188	2	100,594	17.91%	9,630	4,815	-0.57	
Area 16**	500,359	10	50,036	62.40%	50,202	5,020	-2.56	
Area 17	330,164	3	110,055	21.88%	11,583	3,861	-1.28	
Area 18	550,660	8	68,833	13.45%	29,397	3,675	-3.64	
Area 19*	513,357	4	128,339	11.58%	34,506	8,626	1.11	1
Area 20	1,265,403	12	105,450	10.01%	49,329	4,111	-4.69	
Area 21*	143,081	1	143,081		0	0	-1.00	
Area 22*	242,959	2	121,480	43.45%	11,557	5,779	-0.29	
Area 23	220,500	2	110,250	13.79%	13,670	6,835	0.03	
Area 24	192,898	4	48,225	17.17%	16,726	4,182	-1.52	
Area 25*	212,036	1	212,036	17.75%	2,694	2,694	-0.60	
Area 26	284,076	4	71,019	4.97%	11,567	2,892	-2.29	
Area 27	308,600	6	51,433	28.90%	27,359	4,560	-1.95	
Area 28	163,359	2	81,680	4.41%	8,613	4,307	-0.72	
Totals	**10,794,463**	**131**	**82,400**		**616,376**	**4,705**	**-39.69**	

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

On June 16, 2023, FirstHealth submitted updated data to Azzie Conley, Chief of the Acute and Home Care Licensure and Certification Section, which more than doubled the number of procedures (ESTVs) performed at FirstHealth from 10/1/2020-9/30/2021 and from 10/1/21-9/30/22. (Attachment 2) FirstHealth inadvertently did not include ESTVs performed under CPT Codes 77385 and 77386 for these two years. The following table highlights the updated ESTVs reported to the Agency.

ESTVs Reported to the Agency on June 16, 2023

	LRA 23 (FY22)			LRA 22 (FY21)		
	REVISED TOTAL	*REPORTED ON 2023 LRA*		REVISED TOTAL	*REPORTED ON 2022 LRA*	
77372	27	*27*		19	*17*	
77373	514	*511*		443	*437*	
77385	3,380			2,970		
77386	5,362			4,600		
77402	326	*326*		323	*317*	
77407	49	*49*		28	*28*	
77412	6,473	*6,452*		6,234	*6,198*	
77417	302	*302*		728	*720*	
77418						
Grand Total	16,433	*7,667*		15,345	*7,717*	

This change, while significant, does not result in a linear accelerator deficit in Service Area 17 as the following table indicates.

Service Area	2023 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2021-2022 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determination
Area 17	330,164	3	110,055	*	19,424	6,475	-0.12	

* An updated Percentage of Patients from Outside the Service Area could not be calculated.

FirstHealth is specifically requesting that the need for linear accelerators in Service Area 17 be adjusted based on the following data and result in a need determination in the *2024 SMFP* for one (1) linear accelerator in Service Area 17.

Proposed 2024 SMFP Linear Accelerator Need Methodology

The *Proposed 2024 SMFP* identifies a surplus of 1.28 linear accelerators, which updates to a surplus of 0.12 linear accelerators, in Service Area 17, as previously shown. These linear accelerator surpluses result in no need determination of additional linear accelerators in Service Area 17. The need methodology contains three criteria, two of which must be met in order for a deficit to become a need determination. The following summarizes the three criteria and Service Area 17's status:

Criterion 1 – Population per Linear Accelerator

Criterion 1 requires a service area to have a population base of 120,000 per linear accelerator before this criterion can be met. However, this population base was originally recommended by the Inter-Society Council for Radiation Oncology, which no longer exists, in its "Blue Book" dated December 1991, is currently rejected by the American Society for Therapeutic Radiology and Oncology. (Attachment 3) Additionally, the population base of 120,000 per linear accelerator specifically assumes "that 4.1 newly diagnosed cancers will be detected per year per 1,000 people." The most recent Cancer Incidence rates provided by the NCDHHS Division of Public Health NC State Center for Health Statistics (Attachment 4) on its website indicates that every county in Service Area 17 with the exception of Hoke County has a cancer incidence rate of newly diagnosed cancers detected per year per 1,000 people equal to or over 4.1 per 1,000 as the following table highlights:

Cancer Incidence Rate per 1,000 People

Service Area 17 County	Cases	Rate per 100,000	Converted Rate per 1,000*
Hoke	205	400.4	4.0
Lee	394	506.5	5.1
Montgomery	172	413.6	4.1
Moore	745	474.4	4.7
Richmond	297	490.4	4.9
Scotland	209	452.5	4.5

* Converted Rate per 1,000 = Rate per 100,000 / 100

The *Proposed 2024 SMFP* shows that Service Area 17 has a current population of 330,164 or 110,055 per linear accelerator; as a result, Service Area 17 does not meet this criterion. In order for Service Area 17 to meet Criterion 1, Service Area 17 must first reach an overall population of 360,000 or an increase of 30,000 residents.

Criterion 2 – 45% of Patients Residing Outside of Service Area 17

Criterion 2 requires a service area to have over 45% of its patients receiving linear accelerator services originate or reside outside of the service area. The *Proposed 2024 SMFP* shows that Service Area 17 has 21.88% of its patients residing outside of the service area; as a result, Service Area 17 does not meet this criterion. Currently, only two service areas, Service Areas 14 and 16, meet this criterion. Service Area 14 includes UNC Hospitals and Service Area 16 includes Duke University Hospital. Only one other service area, Service Area 10, is within 9 percentage points of meeting Criterion 2.

Criterion 3 – Linear Accelerator Deficit

Criterion 3 requires a service area to have a linear accelerator deficit of greater than or equal to 0.25. The *Proposed 2024 SMFP* shows that Service Area 17 has a linear accelerator surplus of 1.28 linear accelerators, which updates to a surplus of 0.12 linear accelerators; as a result, Service Area 17 does not meet this criterion.

Service Area 17 Data and Information

Service Area Population

Using NC Office of State Budget and Management county population projections, Service Area 17 will not reach 360,000 residents until after 2030. (Attachment 5) The following table shows projected service area population based on simple population trending.

County	Population as of July 1, 2020	Population as of July 1, 2025	Population as of July 1, 2030	Population as of July 1, 2035
Hoke	52,206	58,678	63,805	68,733
Lee	63,396	67,229	70,925	74,621
Montgomery	25,742	25,738	25,737	25,736
Moore	100,024	111,848	123,613	135,321
Richmond	42,915	41,754	40,794	39,833
Scotland	34,156	32,738	32,093	31,456
Service Area 17	**318,439**	**337,985**	**356,967**	**375,700**

Source: https://www.osbm.nc.gov/facts-figures/population-demographics/state-demographer/countystate-population-projections/population-overview

45% Service Area Patient Origination

Based on the historical service area patient origin for Service Area 17, Service Area 17 cannot reasonably project to reach the 45% threshold at any time in the foreseeable future. The following table shows that Service Area 17 with the exception of the 2020 SMFP, has maintained a percentage of service area patients originating from outside of the service area below 25%.

	2020 SMFP	2021 SMFP	2022 SMFP	2023 SMFP	2024 SMFP
Patient Origin Outside of Service Area 17	30.53%	23.44%	25.11%	23.96%	21.88%

Source: *2020 – Proposed 2024 SMFP* (Attachment 6)

Linear Accelerator Deficit

Service Area 17 consists of two linear accelerator providers, FirstHealth and Scotland Memorial Hospital. The presence of the underutilized linear accelerator at Scotland Memorial Hospital has consistently eliminated any linear accelerator deficit needed to meet Criterion 3 in Service Area 17 over the past five SMFPs. Scotland Memorial Hospital provides fewer advanced radiation therapy treatment options compared to FirstHealth. For example, Scotland Memorial Hospital provides stereotactic body radiotherapy ("SBRT") on lung and some prostate cancer, whereas FirstHealth provides SBRT on all sites: lung, spine, prostate, bone metastases, and nodal metastases. Scotland Memorial Hospital does not provide high-does-rate (HDR) brachytherapy or stereotactic radiosurgery (SRS) on the brain, both procedures FirstHealth provides. The following table shows the facility linear accelerator surplus or deficit in Service Area 17 over the past 5 SMFPs.

	Service Area	Accelerators	ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
2020 SMFP	FirstHealth	2	16,461	8,231	0.44	1
	Scotland Memorial	1	3,015	3,015	-0.55	
	Area 17	**3**	**19,476**	**6,492**	**-0.11**	
2021 SMFP	FirstHealth	2	16,437	8,219	0.44	1
	Scotland Memorial	1	4,087	4,087	-0.39	
	Area 17	**3**	**20,524**	**6,841**	**0.04**	
2022 SMFP	FirstHealth	2	15,885	7,943	0.35	1
	Scotland Memorial	1	3,599	3,599	-0.47	
	Area 17	**3**	**19,484**	**6,495**	**-0.11**	
2023 SMFP	FirstHealth	2	15,345	7,673	0.27	1
	Scotland Memorial	1	3,780	3,780	-0.44	
	Area 17	**3**	**19,125**	**6,375**	**-0.17**	
Proposed 2024 SMFP	FirstHealth	2	16,433	8,217	0.43	1
	Scotland Memorial	1	2,991	2,991	-0.56	
	Area 17	**3**	**19,424**	**6,475**	**-0.12**	

Source: *2020 – Proposed 2024 SMFP* (Attachment 7)

As the previous tables indicate, FirstHealth on its own would generate a need, but since the need methodology requires Scotland Memorial's linear accelerator need to be considered, the need methodology does not generate a need determination in Service Area 17. It is not reasonable to expect that patients treated at FirstHealth facilities by FirstHealth physicians will switch to Scotland Memorial Hospital, which is more than 30 miles and approximately 45 minutes from Pinehurst.

FirstHealth Data and Considerations

FirstHealth is the largest provider of linear accelerator services in Service Area 17. In FY2022, FirstHealth provided 16,433 ESTV procedures, while Scotland Memorial Hospital provided 2,991 ESTV procedures. This trend has been consistent as the prior table indicated. As previously stated, the FirstHealth Cancer Center is one of the most complete cancer care programs in North Carolina. In order to accommodate the volume of patients receiving treatments on its two linear accelerators, FirstHealth has had to increase patient throughput and internal efficiencies. FirstHealth is scheduling patients every 10 minutes on its two linear accelerators. As a result, these two linear accelerators are performing more ESTV procedures per linear accelerator that any other linear accelerator provider in North Carolina that provides a total of at least 13,500 ESTV procedures per year, with the exception of New Hanover Regional Medical Center. However, New Hanover Regional Medical Center - Scotts Hill, a campus of New Hanover Regional Medical Center, was recently approved to develop a linear accelerator in January 2022. The following table highlights the 12 linear accelerator providers in North Carolina that provide at least 13,500 ESTV procedures per year. (Attachment 1)

Facility	Linear Accelerators	Total ESTV Procedures	ESTV Procedures per Linear Accelerator	% Different from FMRH
New Hanover Regional Medical Center	4	34,506	8,627	4.8%
FirstHealth Moore Regional	**2**	**16,433**	**8,217**	**0.0%**
Cone Health	4	30,468	7,617	-7.9%
CaroMont Regional Medical Center	3	21,210	7,070	-16.2%
UNC Hospitals	6	39,067	6,511	-26.2%
Atrium Health Carolinas Medical Center	3	19,496	6,499	-26.4%
Duke Raleigh Hospital	4	23,733	5,933	-38.5%
Wake Forest Baptist Medical Center	4	23,199	5,800	-41.7%
Rex Hospital	4	21,356	5,339	-53.9%
Duke University Hospital	8	40,503	5,063	-62.3%
Mission Hospital	3	15,170	5,057	-62.5%
Vidant Radiation Oncology	3	14,375	4,792	-71.5%

As the previous table indicates, FirstHealth is the 10th largest provider of linear accelerator services based on total ESTV procedures in North Carolina. More telling is that of the 12 largest linear accelerator providers based on ESTV procedures in North Carolina, FirstHealth is the only linear accelerator provider utilizing only two linear accelerators to treat patients. The three linear accelerator providers that provide a number of ESTV procedures similar to FirstHealth, Atrium Health Carolina Medical Center, Mission Hospital, and Vidant Radiation Oncology, each operate three linear accelerators. In fact, in comparing the other 11 linear accelerator providers to FirstHealth, eight of the 11 linear accelerator providers performed 25% or more **fewer** ESTV procedures per linear accelerator and all operated three or more linear accelerators.

Additionally, only one other linear accelerator provider in North Carolina, Atrium Health Union (8,279 ESTV procedures on one linear accelerator), provides more ESTV procedures per linear accelerator than FirstHealth.

Statement of the Adverse Effects on Providers or Consumers if the Change is Not Made

FirstHealth has had to make many operational adjustments to accommodate its radiation therapy patients on just two linear accelerators, while taking many concerns into consideration, as the following points highlight:

1. FirstHealth extended the treatment day from 6:00 am – 6:30 pm and sometimes longer just to increase treatment time on the linear accelerators. This requires daily linear accelerator checks starting at 5:00 am and treatments through the lunch hour.

2. FirstHealth's patient population tends to be older and frailer, and they are often unable to drive in the dark and cannot come before sunrise or after sunset.

3. FirstHealth's radiation oncologists now hypo-fractionate delivery, which delivers fewer, higher doses of radiotherapy over a shorter period of time to keep the start delays and the length of the treatment day as low as possible. This allows more patients to receive timely treatment. However, this also causes ESTVs to appear lower due to the hypo-fractionation.

4. Based on the recent studies by ASRT (2020) and ASCO (2019) FirstHealth's volume of patients per linear accelerator greatly exceeds national norms. (Attachment 8)

    - National Average – 25 patients per day, per linear accelerator
    - FirstHealth Average – 38-40 patients per day, per linear accelerator
    - National Average – 5,237 treatments administered per year, per linear accelerator
    - FirstHealth Average – 8,217 treatments administered per year, per linear accelerator

5. Patients currently wait an average of 2 weeks to start treatment based on limited capacity on the linear accelerators, even after these identified adjustments, which increases patient anxiety due to delayed cancer treatment. This is sub-optimal, especially at a time when patients are already experiencing tremendous stress due to their cancer diagnosis.

6. FirstHealth treats a large rural population with limited transportation resources. There are no other cancer centers in the service area with the same advanced treatment offerings; therefore, patients do not have the option to go elsewhere.

Statement of Alternatives Considered and Found Not Feasible

FirstHealth has already implemented the following alternatives over the last several years but the need for a third linear accelerator remains.

- Decreased downtime between patients
- Extended operating hours
- Optimized treatment plans

- Upgraded existing linear accelerators

The following alternatives have been considered but found to be less effective.

- Mobile Linear Accelerator: Several diagnostic and treatment modalities are available via mobile technology; however, mobile linear accelerators do not operate in North Carolina.

- Collaboration with Other Facilities: The only other linear accelerator provider in Service Area 17, Scotland Memorial Hospital, does not offer the full complement of radiotherapy treatments necessary to treat many of FirstHealth's patients. In addition, Scotland Memorial is 45 minutes from FirstHealth Moore Regional.

Developing a third linear accelerator is the only effective alternative to meet the needs of Service Area 17 including patients and FirstHealth.

No Unnecessary Duplication of Health Resources

The proposed special need adjustment for Service Area 17 still requires any applicant to meet the utilization performance standards in 10A NCAC 14C .1903(3). As a result, the special need adjustment would not result in unnecessary duplication of health resources in the service area.

Based on the performance standard required to operate a third linear accelerators, 10A NCAC 14C .1903(5)(a) and (b) requires an applicant to project that the LINACs identified in Items (1) and (2) of this Rule and the proposed LINAC shall perform during the third full fiscal year of operation following completion of the project either: 6,750 or more ESTVs per LINAC; or serve 250 or more patients per LINAC. Currently, FirstHealth's existing ESTV procedures workload meets over 80% of that requirement already. In comparing the other 11 linear accelerator providers on page 7 to FirstHealth, three of the 11 linear accelerator providers provide more than 6,750 ESTV procedures per linear accelerator and eight of the twelve linear accelerator providers performed 6,750 or fewer ESTV procedures per linear accelerator.

Evidence that the Proposed Change is Consistent with the Three Basic Principles Governing the Development of the SMFP: safety and quality, access, and value.

Approving the adjusted need determination for an additional linear accelerator in Service Area 17 is consistent with the three basic principles governing the development of the North Carolina State Medical Facilities Plan: safety and quality, access, and value.

1. Safety and Quality: Adding a third linear accelerator will contribute to safety and quality in several ways:

a) Reducing treatment waiting times: With an additional linear accelerator, FirstHealth can accommodate more patients and reduce treatment waiting times. Faster access to treatment can lead to improved patient outcomes and satisfaction.

b) Enhanced treatment precision: An additional linear accelerator at FirstHealth will provide flexibility in treatment scheduling and enhance the precision of radiation therapy, ensuring the highest quality of care.

c) Redundancy and reliability: An additional linear accelerator at FirstHealth will serve as a redundancy measure. If one linear accelerator experiences downtime or maintenance, the remaining linear accelerators can continue treating patients without interruptions, ensuring a consistent level of patient care.

2. Access: Adding a third linear accelerator will address issues related to patient access to radiation therapy:

a) Capacity to treat more patients: Increased capacity through a third linear accelerator will allow FirstHealth to accommodate more patients, potentially reducing appointment wait times and making radiation therapy more accessible to a larger number of individuals.

b) Meeting growing demand: The population of Service Area 17 is increasing leading to a higher demand for radiotherapy services. Adding a third linear accelerator will help FirstHealth keep up with the growing demand for radiation therapy services.

3. Value: Adding a third linear accelerator will contribute to the overall healthcare value:

a) Economies of scale: By expanding FirstHealth's capacity with an additional linear accelerator, FirstHealth can achieve additional economies of scale, leading to cost savings in the long run.

Summary

FirstHealth is requesting an adjusted need determination of one (1) linear accelerator for Service Area 17 in the *Proposed 2024 SMFP*.

Please refer to Attachment 9 for a letter from FirstHealth radiation oncologists who validate the need for an additional linear accelerator in Service Area 17 and more specifically at FirstHealth.

FirstHealth appreciates the SHCC and staff's time and attention and is pleased to answer any questions.

Attachment 1

C. LINEAR ACCELERATORS

Introduction
G.S. § 131E-176 (14g) defines a ***linear accelerator*** as "a machine used to produce ionizing radiation in excess of 1,000,000 electron volts in the form of a beam of electrons or photons to treat cancer patients."

Table 15C-1 lists the facilities that have linear accelerators. Table 15C-2 lists the facilities that also provide stereotactic radiosurgery treatment using appropriately equipped linear accelerators.

Data Sources
In addition to the data sources listed in the introduction to this chapter, this methodology also obtains the July 1 estimated county population for 2023 provided by the North Carolina Office of State Budget and Management.

Definition
A linear accelerator's ***service area*** is one of the 28 multicounty groupings described in the Assumptions of the Methodology.

Assumptions of the Methodology

1. The methodology incorporates: (a) a geographic accessibility criterion, which is a population base of 120,000 as suggested by the Inter-Society Council for Radiation Oncology; (b) a criterion aimed at assuring efficient use of megavoltage radiation facilities (when Equivalent Simple Treatment Visit [ESTV] procedures divided by 6,750 minus the number of present linear accelerators equals ≥ 0.25); and (c) a patient origin criterion (when a service area has 45% or more of the patients coming from outside the service area). A need determination exists when two of the three criteria are met within a service area.

2. The American College of Radiology recommends use of ESTVs because radiation treatments vary in complexity. In addition, when developing the original methodology, ESTVs were recommended as part of the comments received during public hearings. Providers report procedures by Current Procedural Terminology (CPT) codes, which are converted to ESTVs *(Table 15C-3)*.

3. Patient origin data from the current reporting year forms the basis for defining service areas (*Table 15C-4*). Counties are the basic units for the formation of linear accelerator service areas, based on proximity, utilization patterns, and patient origin data. A small percentage of the population lives some distance from a linear accelerator, but the sparsity of population in and around these areas does not provide the population required to support a linear accelerator. In these cases, two exceptions apply:

   a. Where patient origin data indicates a county's residents primarily use a linear accelerator that is outside their home county, the county is aligned with the county where at least 45% of its residents go for linear accelerator services.

   b. When a county with a linear accelerator has a population less than 120,000, that county is combined with an adjacent county to which the largest percentage of patients go for linear accelerator services, based on patient origin data.

4. Three principal questions must be addressed when determining whether a service area needs an additional linear accelerator:

a. Do the linear accelerators in the service area perform more than 6,750 procedures (ESTVs) per accelerator per year?

b. Is the population of the service area greater than 120,000 per accelerator?

c. Does the patient origin data show that more than 45% of the patients come from outside the service area?

Application of the Methodology
The standard methodology for determining need for linear accelerators is calculated as follows:

Criterion 1:
Step 1: Sum the population estimates for the counties that comprise each linear accelerator service area to determine the population for the service areas *(Table 15C-4)*.

Step 2: For each linear accelerator service area, sum the number of existing linear accelerators, the number of CON-approved linear accelerators under development, and the number of linear accelerators available pursuant to need determinations pending review or appeal *(Table 15C-1)*.

Step 3: Divide the service area population by the result of Step 2 to determine the population residing in the service area per linear accelerator. If the result is greater than or equal to 120,000 per linear accelerator, Criterion 1 is satisfied *(Table 15C-5)*.

Criterion 2:
Step 4: For each service area, use current patient origin data for the reporting year to count the number of patients served on linear accelerators located in the service area, and who reside in a county outside the service area.

Step 5: For each service area, divide the results of Step 4 by the total number of patients served on linear accelerators located in the service area. If more than 45% of total patients served on linear accelerators located in a service area reside outside the service area, then Criterion 2 is satisfied *(Table 15C-5)*.

Criterion 3:
Step 6: For each linear accelerator service area, sum the number of reported ESTV procedures performed on the linear accelerators located in the service area.

Step 7: Divide the results of Step 6 by the number of linear accelerators in the service area which are counted in Step 2 to determine the average number of ESTV procedures performed per linear accelerator in each linear accelerator service area.

Step 8: Divide the results of Step 7 by 6,750 ESTV procedures.

Step 9: Subtract the number of linear accelerators in the service area counted in Step 2 from the results of Step 8. If the difference is greater than or equal to positive 0.25, Criterion 3 is satisfied *(Table 15C-5)*.

If any two of the above three criteria are satisfied in a linear accelerator service area, the service area has a need determination for one additional linear accelerator *(Table 15C-5)*.

Criterion 4:
Regardless of the results of Steps 1-9 above, if a county has a population of 120,000 or more and there is not a linear accelerator counted in Step 2 for that county, a need is determined for one linear accelerator in that county. As a result, the county becomes a separate, new linear accelerator service area.

Unless otherwise specified by the methodology, calculations do not use rounded values. However, fractional values are rounded automatically when displayed.

Table 15C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2021-9/30/2022	Average Number of Procedures per Unit
Harris Regional Hospital	1	Jackson	1	1,355	1,355
North Carolina Radiation Therapy Management Services - Franklin	1	Macon	1	1,984	1,984
Mission Hospital	2	Buncombe	3	15,170	5,057
North Carolina Radiation Therapy Management Services - Asheville	2	Buncombe	1	7,828	7,828
North Carolina Radiation Therapy Management Services - Asheville	2	Buncombe	1	0	0
North Carolina Radiation Therapy Management Services - Weaverville	2	Buncombe	1	2,915	2,915
North Carolina Radiation Therapy Management Services - Clyde	2	Haywood	1	4,308	4,308
North Carolina Radiation Therapy Management Services - Marion	2	McDowell	1	2,872	2,872
Watauga Medical Center	3	Watauga	1	2,336	2,336
Margaret R. Pardee Memorial Hospital	4	Henderson	1	6,194	6,194
North Carolina Radiation Therapy Management Services - Hendersonville	4	Henderson	1	3,536	3,536
North Carolina Radiation Therapy Management - Brevard	4	Transylvania	1	1,521	1,521
UNC Health Blue Ridge - Valdese Campus	5	Burke	2	5,506	2,753
Caldwell UNC Health Care	5	Caldwell	1	0	0
Catawba Valley Medical Center	5	Catawba	2	13,250	6,625
Frye Regional Medical Center - Main Campus	5	Catawba	1	2,737	2,737
Atrium Health Cleveland	6	Cleveland	1	6,561	6,561
CaroMont Regional Medical Center*	6	Gaston	3	21,210	7,070
North Carolina Radiation Therapy Management Services - Forest City	6	Rutherford	1	3,642	3,642
Atrium Health Carolinas Medical Center	7	Mecklenburg	3	19,496	6,499
Atrium Health Pineville	7	Mecklenburg	2	13,016	6,508
Atrium Health University City	7	Mecklenburg	1	7,918	7,918
Matthews Radiation Oncology Center	7	Mecklenburg	2	11,087	5,544
Novant Health Huntersville Medical Center	7	Mecklenburg	1	4,263	4,263
Novant Health Presbyterian Medical Center	7	Mecklenburg	2	12,699	6,350
Atrium Health Union	7	Union	1	8,279	8,279
Iredell Memorial Hospital, Inc.	8	Iredell	2	6,307	3,154
Lake Norman Radiation Oncology	8	Iredell	1	7,994	7,994
Novant Health Cancer Institute-Rowan	8	Rowan	1	6,041	6,041
Atrium Health Cabarrus	9	Cabarrus	3	12,954	4,318
Atrium Heatlh Stanly	9	Stanly	1	3,661	3,661
Novant Health Forsyth Medical Center	10	Forsyth	5	10,631	2,126
Wake Forest Baptist Medical Center	10	Forsyth	4	23,199	5,800
Hugh Chatham Memorial Hospital	10	Surry	1	0	0

Table 15C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2021-9/30/2022	Average Number of Procedures per Unit
Lexington Medical Center	11	Davidson	1	3,181	3,181
Cone Health	12	Guilford	4	30,468	7,617
High Point Medical Center	12	Guilford	2	9,977	4,988
UNC Rockingham Hospital	12	Rockingham	1	2,505	2,505
Randolph Health	13	Randolph	1	3,884	3,884
University of North Carolina Hospitals at Chapel Hill, DBA UNC Hospitals	14	Orange	6	39,067	6,511
Alamance Regional Medical Center	15	Alamance	2	9,630	4,815
Duke Regional Hospital	16	Durham	1	3,497	3,497
Duke University Hospital Main Campus	16	Durham	8	40,503	5,063
Maria Parham Health	16	Vance	1	6,203	6,203
FH Moore Regional Hospital	17	Moore	2	8,592	4,296
Scotland Memorial Hospital	17	Scotland	1	2,991	2,991
Cape Fear Valley Medical Center	18	Cumberland	5	19,399	3,880
Southeastern Regional Medical Center	18	Robeson	2	6,525	3,262
North Carolina Radiation Therapy Management Services - Clinton	18	Sampson	1	3,473	3,473
New Hanover Regional Medical Center**	19	New Hanover	4	34,506	8,626
Franklin County Cancer Center	20	Franklin	1	0	0
2023 Need Determination	20	Wake	1	0	0
Duke Raleigh Hospital	20	Wake	4	23,733	5,933
Rex Hospital	20	Wake	4	21,356	5,339
UNC Hospital Radiation Oncology -Holly Springs	20	Wake	1	0	0
UNC Rex Cancer Center of East Raleigh	20	Wake	1	4,247	4,247
Central Harnett Hospital	21	Harnett	1	0	0
Johnston Health Clayton Professional Plaza	22	Johnston	1	6,319	6,319
Smithfield Radiation Oncology	22	Johnston	1	5,239	5,239
Main Campus	23	Lenoir	1	7,653	7,653
North Carolina Radiation Therapy Management Services - Goldsboro	23	Wayne	1	6,017	6,017
Carteret Health Care	24	Carteret	2	6,980	3,490
CarolinaEast Medical Center	24	Craven	2	9,746	4,873
Onslow Radiation Oncology, LLC	25	Onslow	1	2,694	2,694
North Carolina Radiation Therapy Management Services - Roanoke Rapids	26	Halifax	1	2,484	2,484
Nash Hospitals Inc.	26	Nash	2	7,706	3,853
Wilson Radiation Oncology	26	Wilson	1	1,377	1,377
ECU Health Beaufort Hospital	27	Beaufort	1	4,354	4,354
Vidant Radiation Oncology	27	Hertford	1	2,026	2,026
Vidant Radiation Oncology	27	Pitt	3	14,375	4,792
Vidant Radiation Oncology	27	Pitt	1	6,604	6,604

Table 15C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2021-9/30/2022	Average Number of Procedures per Unit
Outer Banks Health Hospital	28	Dare	1	3,029	3,029
Sentara Albemarle Medical Center	28	Pasquotank	1	5,584	5,584
Totals (73 Facilities)			**131**	**616,376**	**4,705**

* CaroMont Regional Medical Center has two linear accelerators in Gaston County and one linear accelerator in Lincoln County

** New Hanover Regional Medical Center has three linear accelerators in New Hanover County and one linear accelerator in Brunswick County.

Table 15C-2: Stereotactic Radiosurgery Procedures

County	Facility	Number of Procedures
Alamance	Alamance Regional Medical Center	272
Buncombe	Mission Hospital	772
Buncombe	North Carolina Radiation Therapy Management Services - Asheville	264
Buncombe	North Carolina Radiation Therapy Management Services - Weaverville	68
Cabarrus	Atrium Health Cabarrus	498
Carteret	Carteret General Hospital	310
Catawba	Catawba Valley Medical Center	369
Catawba	Frye Regional Medical Center	101
Cleveland	Atrium Health Cleveland	140
Craven	CarolinaEast Medical Center	361
Cumberland	Cape Fear Valley Medical Center	274
Durham	Duke Regional Hospital	19
Durham	Duke University Hospital	2,609
Forsyth	Atrium Health Wake Forest Baptist	686
Forsyth	Novant Health Forsyth Medical Center	555
Franklin	North Carolina Radiation Therapy Management Services - Franklin	4
Gaston	CaroMont Regional Medical Center	254
Guilford	Cone Health	868
Guilford	High Point Regional Health	223
Haywood	North Carolina Radiation Therapy Management Services - Clyde	85
Henderson	North Carolina Radiation Therapy Management Services - Hendersonville	13
Henderson	Margaret R. Pardee Memorial Hospital	17
Iredell	Iredell Memorial Hospital	125
Jackson	Harris Regional Hospital	75
Johnston	Smithfield Radiation Oncology	22
Lenoir	UNC Lenoir Health Care	212
McDowell	North Carolina Radiation Therapy Management Services - Marion	66
Mecklenburg	Atrium Health University City	50
Mecklenburg	Carolinas Medical Center/Center for Mental Health	910
Mecklenburg	Novant Health Huntersville Medical Center	95
Mecklenburg	Atrium Health Pineville	96
Mecklenburg	Novant Health Presbyterian Medical Center	632
Mecklenburg	University Radiation Therapy Center	50
Mecklenburg	Matthews Radiation Oncology Center	13
Moore	FirstHealth Moore Regional Hospital and Pinehurst Treatment Cntr.	538
New Hanover	New Hanover Regional Medical Center	1,368
Orange	University of North Carolina Hospitals	1,353
Robeson	Southeastern Regional Medical Center	82
Rockingham	UNC Rockingham Hospital	5
Rowan	Novant Health Rowan Medical Center	137
Rutherford	North Carolina Radiation Therapy Management Services - Forest City	67
Scotland	Scotland Memorial Hospital	0
Rutherford	North Carolina Radiation Therapy Management Services - Brevard	0
Surry	Hugh Chatham Memorial Hospital	0
Union	Atrium Health Union	70
Wake	Duke Raleigh Hospital	607
Wake	Rex Hospital	564
Wayne	North Carolina Radiation Therapy Management Services - Goldsboro	17
Watauga	Watauga Medical Center	73
Wilson	Wilson Medical Center	42
Total		**16,031**

Table 15C-3: Linear Accelerator Treatment Data - Hospital and Free-Standing

CPT Code	Description	ESTVs/ Procedures Under ACR
Simple Treatment Delivery		
77401	Radiation treatment delivery	1.00
77402	Radiation treatment delivery (<=5 MeV)	1.00
77403	Radiation treatment delivery (6-10 MeV)	1.00
77404	Radiation treatment delivery (11-19 MeV)	1.00
77406	Radiation treatment delivery (>=20 MeV)	1.00
Intermediate Treatment Delivery		
77407	Radiation treatment delivery (<=5 MeV)	1.00
77408	Radiation treatment delivery (6-10 MeV)	1.00
77409	Radiation treatment delivery (11-19 MeV)	1.00
77411	Radiation treatment delivery (>=20 MeV)	1.00
Complex Treatment Delivery		
77412	Radiation treatment delivery (<=5 MeV)	1.00
77413	Radiation treatment delivery (6-10 MeV)	1.00
77414	Radiation treatment delivery (11-19 MeV)	1.00
77416	Radiation treatment delivery (>= 20 MeV)	1.00
Other CPT Codes		
77417	Additional field check radiographs	.50
77418	Intensity modulated radiation treatment (IMRT) delivery	1.00
77371	Radiation treatment delivery, stereotactic radiosurgery (SRS), complete course of treatment of cranial lesion(s) consisting of 1 session; multisource Cobalt 60 based (Gamma Knife)	3.00
77372	Radiation treatment delivery, stereotactic radiosurgery (SRS), complete course of treatment of cranial lesion(s) consisting of 1 session; linear accelerator	3.00
77373	Stereotactic body radiation therapy, treatment delivery, per fraction to 1 or more lesions, including image guidance, entire course not to exceed 5 fractions	3.00
G0339	(Image-guided) robotic linear accelerator-based stereotactic radiosurgery in one session or first fraction	3.00
G0340	(Image-guided) robotic linear accelerator-based stereotactic radiosurgery, fractionated treatment, 2nd-5th fraction	3.00
	Total body irradiation	2.50
	Hemibody irradiation	2.00
	Intraoperative radiation therapy (conducted by bringing the anesthetized patient down to the linear accelerator)	10.00
	Neutron and proton radiation therapy	2.00
	Limb salvage irradiation	1.00
	Pediatric patient under anesthesia	1.50

Table 15C-4: Linear Accelerator Service Areas

Area	County	2023 Total Population
1	Cherokee	29,387
1	Clay	11,573
1	Graham	8,067
1	Jackson	43,331
1	Macon	37,957
1	Swain	14,370
	Total	**144,685**
2	Buncombe	277,266
2	Haywood	63,282
2	Madison	21,598
2	McDowell	44,773
2	Mitchell	14,854
2	Yancey	18,439
	Total	**440,212**
3	Ashe	26,685
3	Avery	17,951
3	Watauga	53,561
	Total	**98,197**
4	Henderson	118,043
4	Polk	19,585
4	Transylvania	33,609
	Total	**171,237**
5	Alexander	36,560
5	Burke	87,923
5	Caldwell	81,075
5	Catawba	163,845
	Total	**369,403**
6	Cleveland	102,680
6	Gaston	241,175
6	Lincoln	93,144
6	Rutherford	64,350
	Total	**501,349**
7	Anson	21,433
7	Mecklenburg	1,159,791
7	Union	252,232
	Total	**1,433,456**
8	Iredell	200,590
8	Rowan	150,169
	Total	**350,759**
9	Cabarrus	240,512
9	Stanly	63,008
	Total	**303,520**
10	Alleghany	11,142
10	Davie	44,223
10	Forsyth	388,365
10	Stokes	45,205
10	Surry	71,283
10	Wilkes	65,600
10	Yadkin	37,082
	Total	**662,900**

Table 15C-4: Linear Accelerator Service Areas

Area	County	2023 Total Population
11	Davidson	173,876
	Total	**173,876**
12	Guilford	546,934
12	Rockingham	91,991
	Total	**638,925**
13	Randolph	146,470
	Total	**146,470**
14	Chatham	79,708
14	Orange	151,126
	Total	**230,834**
15	Alamance	178,943
15	Caswell	22,245
	Total	**201,188**
16	Durham	337,195
16	Granville	62,776
16	Person	39,681
16	Vance	41,815
16	Warren	18,892
	Total	**500,359**
17	Hoke	56,404
17	Lee	65,751
17	Montgomery	25,745
17	Moore	107,122
17	Richmond	42,137
17	Scotland	33,005
	Total	**330,164**
18	Bladen	29,077
18	Cumberland	345,250
18	Robeson	117,372
18	Sampson	58,961
	Total	**550,660**
19	Brunswick	157,537
19	Columbus	49,851
19	New Hanover	238,240
19	Pender	67,729
	Total	**513,357**
20	Franklin	75,698
20	Wake	1,189,705
	Total	**1,265,403**
21	Harnett	143,081
	Total	**143,081**
22	Johnston	242,959
	Total	**242,959**
23	Duplin	48,754
23	Lenoir	54,299
23	Wayne	117,447
	Total	**220,500**

Table 15C-4: Linear Accelerator Service Areas

Area	County	2023 Total Population
24	Carteret	69,296
24	Craven	102,142
24	Jones	9,195
24	Pamlico	12,265
	Total	**192,898**
25	Onslow	212,036
	Total	**212,036**
26	Edgecombe	47,122
26	Halifax	47,359
26	Nash	95,428
26	Northampton	16,854
26	Wilson	77,313
	Total	**284,076**
27	Beaufort	44,244
27	Bertie	16,655
27	Greene	20,120
27	Hertford	19,365
27	Hyde	4,495
27	Martin	21,291
27	Pitt	172,005
27	Washington	10,425
	Total	**308,600**
28	Camden	11,144
28	Chowan	13,722
28	Currituck	32,208
28	Dare	38,392
28	Gates	10,247
28	Pasquotank	40,887
28	Perquimans	13,598
28	Tyrrell	3,161
	Total	**163,359**

Table 15C-5: Linear Accelerator Service Areas and Calculations

Service Area	2023 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2021-2022 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	144,685	2	72,343	15.69%	3,339	1,670	-1.51	
Area 2	440,212	8	55,027	27.38%	33,093	4,137	-3.10	
Area 3	98,197	1	98,197	14.06%	2,336	2,336	-0.65	
Area 4	171,237	3	57,079	11.25%	11,251	3,750	-1.33	
Area 5	369,403	6	61,567	17.67%	21,492	3,582	-2.82	
Area 6	501,349	5	100,270	10.10%	31,413	6,283	-0.35	
Area 7	1,433,456	12	119,455	22.00%	76,757	6,396	-0.63	
Area 8	350,759	4	87,690	28.57%	20,341	5,085	-0.99	
Area 9	303,520	4	75,880	25.30%	16,615	4,154	-1.54	
Area 10	662,900	10	66,290	36.73%	33,830	3,383	-4.99	
Area 11*	173,876	1	173,876	20.57%	3,181	3,181	-0.53	
Area 12	638,925	7	91,275	20.23%	42,949	6,136	-0.64	
Area 13*	146,470	1	146,470	13.70%	3,884	3,884	-0.42	
Area 14**	230,834	6	38,472	74.69%	39,067	6,511	-0.21	
Area 15	201,188	2	100,594	17.91%	9,630	4,815	-0.57	
Area 16**	500,359	10	50,036	62.40%	50,202	5,020	-2.56	
Area 17	330,164	3	110,055	21.88%	11,583	3,861	-1.28	
Area 18	550,660	8	68,833	13.45%	29,397	3,675	-3.64	
Area 19*	513,357	4	128,339	11.58%	34,506	8,626	1.11	1
Area 20	1,265,403	12	105,450	10.01%	49,329	4,111	-4.69	
Area 21*	143,081	1	143,081		0	0	-1.00	
Area 22*	242,959	2	121,480	43.45%	11,557	5,779	-0.29	
Area 23	220,500	2	110,250	13.79%	13,670	6,835	0.03	
Area 24	192,898	4	48,225	17.17%	16,726	4,182	-1.52	
Area 25*	212,036	1	212,036	17.75%	2,694	2,694	-0.60	
Area 26	284,076	4	71,019	4.97%	11,567	2,892	-2.29	
Area 27	308,600	6	51,433	28.90%	27,359	4,560	-1.95	
Area 28	163,359	2	81,680	4.41%	8,613	4,307	-0.72	
Totals	**10,794,463**	**131**	**82,400**		**616,376**	**4,705**	**-39.69**	

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

Table 15C-6: Linear Accelerators Need Determination*

(Proposed for Certificate of Need Review Commencing in 2024)

Service Area	Linear Accelerator Need Determination	Certificate of Need Application Deadline**	Certificate of Need Beginning Review Date
Service Area 19	1	To be determined	To be determined
It is determined that there is no need anywhere else in the state and no other reviews are scheduled.			

* Any person can apply for a CON to meet the need, not just the health service facility or facilities that generated the need.

** Application deadlines are absolute, pursuant to 10A NCAC 14C.0202(2). The filing deadline is 5:00 p.m. on the application deadline date.

Attachment 2

dlegarth@nc.rr.com

From:	Phillips, Felicia <FPhillips@firsthealth.org>
Sent:	Friday, June 16, 2023 4:22 PM
To:	'Conley, Azzie'
Cc:	'David Legarth'
Subject:	MRH LIN ACC DATA CHANGES FOR LRA19 - LRA23
Attachments:	winmail.dat

Good afternoon Azzie. I hope you are doing well. I wasn't sure who to contact after Linda's retirement, so you are the lucky one today!

After reviewing FirstHealth Moore Regional Hospital's licensure renewal applications, we found an error in the linear accelerator data. Please find attached the worksheet showing the revised data highlighted in yellow for each license renewal timeframe.

If you have any questions, please do not hesitate to contact me.

Thank you, f.

PS - I received an 'undeliverable' message for this message sent Wednesday. Please let me know when you receive this one. Thank you.

Felicia Phillips
FirstHealth of the Carolinas, Inc.
Department of Strategy and Innovation
Sr. Planning Analyst
910.715.5472

FIRSTHEALTH MOORE REGIONAL HOSPITAL
LICENSE NO: H0100
LINEAR ACCELERATOR TREATMENT DATA (INCLUDING CYBERKNIFE & SIMILAR EQUIPMENT)
***REVISION SUBMISSION FOR LRA 19 THROUGH LRA 23**

	LRA 23 (FY22)		LRA 22 (FY21)		LRA 21 (FY20)		LRA 20 (FY19)		LRA
	REVISED TOTAL	*REPORTED ON 2023 LRA*	REVISED TOTAL	*REPORTED ON 2022 LRA*	REVISED TOTAL	*REPORTED ON 2021 LRA*	REVISED TOTAL	*REPORTED ON 2020 LRA*	REVISED TOTAL
77372	27	*27*	19	*17*	16	*16*	17	*17*	17
77373	514	*511*	443	*437*	439	*438*	326	*326*	233
77385	3,380		2,970		2,914		2,952		3,263
77386	5,362		4,600		3,782		3,460		2,813
77402	326	*326*	323	*317*	248	*253*	373	*379*	407
77407	49	*49*	28	*28*	47	*47*	71	*70*	79
77412	6,473	*6,452*	6,234	*6,198*	7,012	*6,960*	7,877	*7,857*	8,434
77417	302	*302*	728	*720*	1,244	*1,245*	1,402	*1,415*	1,527
77418						*6,640*		*6,394*	
Grand Total	**16,433**	***7,667***	**15,345**	***7,717***	**15,702**	***15,599***	**16,478**	***16,458***	**16,773**

*please revise the above license renewal applications with the data highlighted in yellow.

Prepared by: Felicia Phillips/Strategy & Innovation
Source: PA/DHRS LRAs

19 (FY18)
REPORTED ON 2019 LRA
18
233
403
78
8405
1542
6051
16730

Prepared by: Felicia Phillips/Strategy & Innovation
Source: PA/DHRS LRAs

Attachment 3

Radiation Oncology in Integrated Cancer Management

Report of the Inter-Society Council for Radiation Oncology

Sponsored by the:

- American Association of Physicists in Medicine
- American College of Medical Physics
- American College of Radiology
- American Radium Society
- American Society for Therapeutic Radiology and Oncology
- North American Hyperthermia Group
- Radiation Research Society
- Radiological Society of North America
- Society of Chairmen of Academic Radiation Oncology Programs

DECEMBER 1991

TABLE OF CONTENTS

Tables

Prior "Bluebooks"

1968 – A Prospect for Radiation Therapy in the United States

1972 – A Proposal for Integrated Cancer Management in the United States: The Role of Radiation Therapy

1981 – Criteria for Radiation Oncology in Multidisciplinary Cancer Management

1986 – Radiation Oncology in Integrated Cancer Management

Subcommittee to Write "Radiation Oncology in Integrated Cancer Management"

Robert G. Parker, M.D. (Chair)
C. Robert Bogardus, M.D.
Gerald E. Hanks, M.D.
Colin G. Orton, Ph.D.
Marvin Rotman, M.D.

Inter-Society Council for Radiation Oncology (ISCRO)

Gerald E. Hanks, M.D.	Chairman, ISCRO
Peter R. Almond, Ph.D.	Vice Chairman, ISCRO
	American Association of Physicists in Medicine
Bengt E. Bjarngard E., Ph.D.	American Association of Physicists in Medicine
Luther W. Brady, M.D.	American Society for Therapeutic Radiology and Oncology
C. Norman Coleman, M.D.	American Society for Therapeutic Radiology and Oncology
Mark W. Dewhirst, Ph.D.	North American Hyperthermia Group
Sarah S. Donaldson, M.D.	American College of Radiology
John D. Earle, M.D.	Radiological Society of North America
Mortimer M. Elkind, Ph.D.	Radiation Research Society
George M. Hahn, Ph.D.	North American Hyperthermia Group
Rodney R. Million, M.D.	Society of Chairmen of Academic Radiation Oncology Programs
James B. Mitchell, Ph.D.	Radiation Research Society
Colin G. Orton, Ph.D.	American College of Medical Physics
Robert G. Parker, M.D.	Radiological Society of North America
Lester J. Peters, M.D.	American College of Radiology
Leonard R. Prosnitz, M.D.	American Radium Society
Marvin Rotman, M.D.	Society of Chairmen of Academic Radiation Oncology Programs
Alfred R. Smith, Ph.D.	American College of Medical Physics
J. Frank Wilson, M.D.	American Radium Society

August 5, 1991

Gerald Hanks, M.D.
Chairman, Inter-Society Council for Radiation Oncology
Department of Radiation Oncology
Fox Chase Cancer Center
Central and Shelmire Avenues
Philadelphia, PA 19111

Dear Gerry:

The fifth "Blue Book," Radiation Oncology in Integrated Cancer Management, has been completed. This document continues an evolution from, *A Prospect for Radiation Therapy in the United States* (1968), *A Proposal for Integrated Cancer Management in the United States: The Role of Radiation Oncology* (1972), *Criteria for Radiation Oncology in Multidisciplinary Cancer Management* (1981) and *Radiation Oncology in Integrated Cancer Management* (1986).

The sections on Quality Assurance and Criteria for Utilization of Equipment and Facilities have been extensively revised and a section on Economic Issues has been added.

Members representing the professional societies which comprise the Inter-Society Council for Radiation Oncology support this document.

Sincerely,

Robert G. Parker, M.D., Chair
ISCRO Subcommittee for
Revision of the "Blue Book"

August 5, 1991

Eli Glatstein, M.D.
NCI, Department of Radiation Oncology
Building 10, Room B3-B69
9000 Rockville Pike
Bethesda, MD 20892

Dear Eli:

The Inter-Society Council for Radiation Oncology is a group of radiation oncologists, biologists, and physicists who are organized to foster the development of research, education, and the clinical sciences in the field of radiation oncology. We actively review research proposals and undertake projects with the purpose of improving cancer treatment.

I am pleased to present you with a copy of the final draft of the fifth edition of "Radiation Oncology in Multidisciplinary Cancer Management," commonly known as the "Blue Book."

Traditionally, the Blue Book has received the endorsement of the National Cancer Institute and ISCRO now would welcome your endorsement of the 1991 edition.

As you are aware, the Blue Book is extremely important in the planning and staffing of radiation therapy facilities. Perhaps, most importantly, it has become the back bone of quality assurance programs.

This 1991 edition of the Blue Book has two objectives. Reasonable standards for radiation therapy, inclusive of those for personnel, equipment, facilities and operations, are defined, and guidelines for the optimal use of radiation therapy in the integrated management of patients with cancer are suggested.

Thank you for you consideration of our request and I look forward to hearing from you.

Sincerely,

Gerald E. Hanks, M.D.
Chairman

August 27, 1991

Dr. Gerald E. Hanks
Chairman
Inter-Society Council for Radiation Oncology
1101 Market Street
14th Floor
Philadelphia, PA 19107

Dear Dr. Hanks:

I commend you and ISCRO subcommittee members for the 1991 "Blue Book" revision entitled, "Radiation Oncology in Multidiciplinary Cancer Management." This report, the fifth edition prepared by the radiation oncology community, succinctly presents the standards for clinical practice and the objectives for radiation oncology during the remainder of the 1990s. Your evaluation of the criteria for standard radiotherapy practice is particularly important at this time because multi-modality cancer treatment has an increasing number of cancer patients. Your continued effort to provide standards for radiation oncologists as well as guidelines for health care leaders is an excellent example for other oncologic disciplines.

The National Cancer Institute established the Radiation Research Program in 1982, and this program continues to provide a visible and strong focus within the NCI for support of research and related activities in radiation oncology, diagnosis, biology, and physics, Your activities represent an important complement to the research initiators sponsored by the NCI program.

I am pleased to endorse the 1991 report and once again encourage you and your colleagues in the radiation oncology community to continue your efforts in the conquest of cancer.

Sincerely,

Eli Glatstein, M.D., Acting Director
Radiation Research Program
National Cancer Institute

August 12, 1991

Gerald Hanks, M.D.
Chairman, Inter-Society Council for Radiation Oncology
Department of Radiation Oncology
Fox Chase Cancer Center
Central and Shelmire Avenues
Philadelphia, PA 19111

Dear Dr. Hanks:

On behalf of the Commission on Radiation Oncology of the American College of Radiology, I wish to commend you and your colleagues for the work you have done in revising the "Blue Book." This fifth edition, "Radiation Oncology in Integrated Cancer Management," builds effectively on the strong foundation established by the previous four versions which, since 1968, have placed radiation oncology in a unique position within cancer management by having established criteria for the proper delivery of radiation therapy. This document will serve, as its predecessors have, to provide the most up-to-date elements of the structure and process for providing the most effective radiation therapy. Personnel and equipment requirements, programs for monitoring the quality of patient care, and descriptions of the key interactions with the patients, are well described. It will serve well the needs of cancer patients and those committed to providing the best care for those patients, throughout the last decade of the 20th Century.

Sincerely,

James D. Cox, M.D., Chairman
Commission on Radiation Oncology
American College of Radiology

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I. Introduction

Every patient with cancer should have access to the best possible care regardless of constraints such as geographic separation from adequate facilities and professional competence, economic restrictions, cultural barriers or methods of health care delivery. Suboptimal care is likely to result in an unfavorable outcome for the patient, at greater expense for the patient and for society.

The major components of treatment continue to be surgery, radiation therapy and systemic chemotherapy. Optimal use of these therapeutic modalities requires proper *initial* management decisions. These decisions must be made by health care professionals, who have an understanding of the biology of cancer in the human and the treatment options.

Potential contributions and liabilities of each treatment method must be presented by surgeons, medical oncologists and radiation oncologists as equal members of the patient management team. Essential pretreatment interaction amongst surgeons, medical oncologists and radiation oncologists should continue throughout the course of treatment and the long-term follow-up for every patient.

Patients with cancer, and/or their selected advisors or relatives, must have the opportunity to become fully informed about their medical status, all of the reasonable treatment options and the likely consequences of each management program and even of no treatment. This right of patients to participate in decisions related to their care must be respected at all times.

There are many different approaches to providing *optimal* care. These are tailored to local needs and resources. However, in every circumstance, the integration of highly trained personnel and expensive facilities is required. High quality radiation therapy can be provided most efficiently when the number of patients is large enough to fully utilize the necessary expertise and expensive facilities. Currently, in the United States, at least 50% of facilities have only one megavoltage radiation treatment unit, and approximately 25% are staffed by a single physician either full-time or part-time[1]. It is essential that these limited facilities, whether located in a hospital or free-standing, have the capability for the same high quality patient care available in larger centers. Treatment planning skills, a computer-based treatment planning system, simulation, direct medical radiation physicist involvement, high energy photon and electron beams, skilled brachytherapy and the capability to fabricate treatment aids must be available to the patients in small facilities, either on-site or through arrangements with nearby centers.

Although good radiation therapy programs always have included procedures specifically designed to minimize error and risk and to promote consistent high quality patient care, these activities have become formalized Quality Assurance Programs.

Multiple groups within and outside medical centers now require extensive documentation of compliance with defined standards as a requisite of continued approval of the program and the affiliated medical center.

The costs of health care in general, and for patients with cancer specifically, have come under increased scrutiny. Although the support of radiation therapy in the United States consumes less than 0.5% of health care expenses (Powers, W.E., personal communication, 1989), the expensive facilities and extensively trained personnel are likely targets for cost containment.

Consequently, expanded and updated sections on Quality Assurance and Utilization of Facilities and Equipment are included in this publication.

[1]Facility Master List Survey, Patterns of Care Study, American College of Radiology

II. Objectives of this Report

In this report:

1) reasonable standards for radiation therapy, inclusive of those for personnel, equipment, facilities and operations, will be defined; and
2) guidelines for the optimal use of radiation therapy in the integrated management of patients with cancer will be suggested.

III. Goals of Cancer Management

The primary goal of health care personnel and their supporting organizations, and of society generally, is to provide the best possible care to every patient with cancer. The objectives of cure, palliation or long-term tumor control must be clearly defined. Each patient, whether part of an organized study or not, must become a source of information available for continual improvement of therapeutic performance. Concurrently, better methods, equipment and facilities must be developed, and educational programs must be provided for personnel.

IV. The Clinical Role of Radiation Therapy

Surgery, radiation therapy and systemic chemotherapy remain the bases of the management of patients with cancer. Hopefully, other methods, such as those modulating the host's immune system, will soon prove useful, at least as adjuvants.

The usual objective of surgery or radiation therapy is local/regional control of tumor. In addition, ionizing radiations may be used as a systemic agent. Chemotherapy usually is used systemically, although it may, on occasion, be used regionally. Surgery, radiation therapy and chemotherapy can be used individually or in various combinations and sequences.

Currently, radiation therapy is used in the management of 50–60% of all patients with cancer. Its use, as for surgery and chemotherapy, must be decided and controlled by specifically trained, competent personnel.

Radiation therapy may be used alone or with other treatments to cure humans with cancers arising in nearly every anatomic site. The inherent advantage of the method is the preservation of anatomic structures and their function. Today, cure should be the objective for approximately 50% of all patients treated. For these patients, cost, inconvenience and iatrogenic morbidity may be of less concern than they are for those unfortunate patients, who are not curable by currently available methods.

Properly used, radiation therapy is a superb palliative agent with a high likelihood of success and easily controlled or avoided morbidity. Examples are: relief of pain from bony metastases; preservation of skeletal integrity; reduction of intracranial pressure with resultant relief of headaches and neurological dysfunction; restoration of the patency of tumor-compromised lumina (esophageal, bronchial, vascular); and control of tumor-induced bleeding.

Conventional, external beam radiation therapy (teletherapy) ısually is delivered in single daily increments for several weeks. Currently, there are ongoing trials of the use of multiple increments daily over the same period (hyperfractionation) or over shorter times (accelerated fractionation). The prolonged period of treatment provides an opportunity for all members of the radiation oncology team to provide support to patients.

Intraoperative radiation therapy, using single increments of X-rays or electron beams directed to targets exposed at surgery, is being investigated. The potential advantage is the physical displacement or protection of normal structures from the radiation beam. Inasmuch as a fractionated high total dose is not possible with this approach, it is used to deliver a large "boost" dose.

Brachytherapy, exploiting a variety of radionuclide sources, is used primarily for cancers arising in the head and neck, breast and pelvis. The advantage of this method is delivery of a dose to a tumor, which is relatively higher than that delivered to adjacent normal tissues. In most instances, such interstitial and intracavitary placement of radioactive sources is an operative procedure requiring an anesthetic for the patient.

Particles, both charged (protons, helium ions, heavy ions) and unchanged (neutrons) are being investigated, both as teletherapy beams and brachytherapy agents. Such particles produce more dense ionization in tissues and so theoretically reduce the adverse influence of cellular hypoxia and the effect of position in the cell cycle at the time of irradiation.

Augmentation of the therapeutic effectiveness of ionizing radiations, through the use of adjuvants, is being investigated. Heat applied regionally may be cytotoxic at 42–45°C, and it may augment cell killing by ionizing radiations or chemotherapeutic agents. Selective effectiveness of heat against cancer cells is based on the diminished blood flow in tumors relative to normal tissue with consequent decreased ability to dissipate heat and maintain normal homeostasis. Several systemically administered drugs may increase the sensitivity of cells to ionizing radiations. Some of these, such as doxyrubicin and dactinomycin, unfortunately, may increase the radiation sensitivity of both tumor and normal cells and, consequently, a therapeutic advantage does not result. Electron-affinic compounds may lessen the adverse effects of tumor cell hypoxia on radiosensitivity.

Total body irradiation, long used in multiple small doses as a therapeutic agent in hematopoietic and lymphomatous disorders, is used in larger doses to destroy abnormal (and normal) bone marrow prior to the transplantation of healthy marrow. Total body irradiation, or total nodal irradiation, is used to suppress the immune system in a variety of diseases.

V. The Process of Radiation Therapy

The clinical use of ionizing radiations is a complex process nvolving highly trained personnel in a variety of interrelated activiies (Tables V–1A and V–1B).

A critical step is the initial evaluation of the patient and an ıssessment of the tumor. This requires a pertinent history, complete ›hysical examination, a review of all diagnostic studies and reports ınd discussion with the referring physician.

The radiation oncologist must be aware of the biologic charıcteristics of the patient's cancer as a basis for estimating its clinical ›ehavior and planning treatment. The documented extent of each :ancer must be recorded as a basis for staging. This will support an :stimate of the prognosis for each patient and will enable comparison ›f treatment performances between different medical centers.

Initial decisions about therapy include: an estimate of whether reatment is likely to help the patient; selection of cure or palliation as he objective; and identification of alternative therapies with consid:ration of their relative merits. If ionizing radiations are to be used, the ›eam characteristics and/or radionuclide sources, the method and ›attern of delivery, doses and sequencing with other treatments must ›e known.

It is important to discuss these initial tentative decisions with he patient's other physicians, the patient and responsible family nembers or designees.

Treatment planning requires determination of the tumor site and :xtent in relation to normal tissues. This assessment is based on ›hysical examination, endoscopy, diagnostic imaging and findings at ;urgery. The relative contributions of external radiation beams, ›rachytherapy, intraoperative irradiation and adjuvants need to be :onsidered. The radiation oncologist specifies the doses desired hroughout the tumor and sets limits of doses to critical structures. The physician, medical radiation physicist and dosimetrist then

Table V-1A

Process of Radiation Therapy (External Beam)

1. **CLINICAL EVALUATION**
   Initial multidisciplinary evaluation of patient
   Decision for radiation therapy
   Assessment of pathobiology of tumor
   Staging

2. **THERAPEUTIC DECISION-MAKING**
   Selection of treatment goals—cure/palliation
   Choice of modalities of treatment

3. **TARGET VOLUME LOCALIZATION**
   Definition of tumor extent and potential routes of spread
   Identification of sensitive organs and tissues

4. **TREATMENT PLANNING**
   Selection of treatment technique
   Computation of dose distribution and verification of accuracy
   Determination of dose/time/volume relationship

5. **SIMULATION OF TREATMENT**
   Selection of immobilization devices
   Radiographic documentation of treatment ports
   Measurement of patient
   Construction of patient contours
   Shaping of fields

6. **FABRICATION OF TREATMENT AIDS**
   Construction of custom blocks, compensating filters

7. **TREATMENT**
   Initial verification of treatment set-up
   Verification of accuracy of repeated treatments
   Continual assessment of equipment performance
   Periodic checks of dosimetry, record keeping

8. **PATIENT EVALUATION DURING TREATMENT**
   Evaluation of tumor response
   Assessment of tolerance to treatment

9. **FOLLOW-UP EVALUATION**
   Evaluation of tumor control
   Assessment of complications of treatment

Table V-1B
Process of Radiation Therapy (Brachytherapy)

1. **CLINICAL EVALUATION**
   Initial multidisciplinary evaluation of patient
   Decision for radiation therapy
   Assessment of pathobiology of tumor
   Staging

2. **THERAPEUTIC DECISION-MAKING**
   Selection of treatment goals — cure/palliation
   Choice of modalities of treatment

3. **TARGET VOLUME LOCALIZATION**
   Definition of tumor extent and potential routes of spread
   Identification of sensitive organs and tissues

4. **TREATMENT PLANNING**
   Selection of volume to be treated
   Selection of geometry for application
   Computation of doses and dose distributions
   Estimation of tolerance to procedure
   Check off of equipment
   Arrangement for surgical suite and anesthesia

5. **TREATMENT**
   Examination of anesthetized patient
   Review of initial treatment plan
   Implantation

6. **VERIFICATION OF IMPLANTATION**
   Orthogonal or stereo radiographs

7. **DOSIMETRY**
   Calculation from actual implantation
   Establishment of time for removal

8. **PATIENT EVALUATION DURING TREATMENT**
   Assessment of tolerance
   Check of position of implant

9. **REMOVAL OF IMPLANT**

10. **FOLLOW-UP EVALUATION**
    Assessment of early and late sequelae
    Evaluation of tumor control

design potential treatment deliveries which satisfy these requirements. The calculation of doses at multiple sites and the mapping of isodose patterns, based on accurately measured doses and other physical characteristics, usually require the use of special computer programs. The physician, upon the advice of the medical radiation physicist and dosimetrist, then selects the best treatment plan for the individual patient.

After the therapeutic approach is selected, the target volume is confirmed and recorded radiographically at simulation. Simulators are specialized units which can reproduce all of the motions of the specific treatment unit to be used. Orthogonal radiographic units are being supplemented by units which display cross-section anatomy. The use of cross-section anatomy (CT scans) supports three-dimensional definition of the target volume. Such use allows immediate treatment planning with later simulation for field marking, identification of treatment unit parameters and radiographic verification of the treatment set-up. The availability of fluoroscopy aids and hastens the process. Simulation, which may be a two-step process, is carried out by a specially trained radiation therapy technologist under the supervision of the radiation oncologist.

Devices to aid in positioning and immobilizing the patient, normal tissue shields, compensating filters and other aids need to be designed and fabricated. This requires access to a specialized preparation room and a machine shop.

Prior to initiation of treatment, radiographs produced by the treatment beam of the teletherapy unit are compared to the simulator films to verify that the beams and targets are identical. Dosimeters may be used, *in vivo*, to measure and record actual doses at specific anatomic sites.

Daily treatments are carried out by radiation therapy technologists who are under the direct supervision of the radiation oncologist and the medical physicist. It is essential that all treatment applications be described in detail (orders) and signed by the responsible physician. Likewise, any changes in the planned treatment by the physician may require adjustment in immobilization, new calculations and even a new treatment plan. Thus, the technologist, physicist and dosimetrist need to be notified.

Although the daily treatment is set up on the teletherapy unit by technologists, a responsible physician must be available in the department or nearby for confirmation of the treatment, if necessary, and for unscheduled decisions and supervision of personnel. A variety of specific checks to insure conformity to the planned treatment should be in place. Therefore, a physician does not need to visually check each treatment set-up.

The responsible physician monitors the patient's progress by checking the daily entries in the treatment chart and discussing the patient with the technologists, nurses, relatives or friends, and other involved physicians and by periodic examinations. Re-evaluation examinations usually are scheduled at least weekly. Portal verification films, pertinent laboratory and visual imaging studies are periodically ordered and reviewed. The patient, referring physician and responsible friends and/or relatives should be informed of the progress of treatment.

Periodic post-treatment assessment of the accomplishments and possible sequelae of treatment is essential. The radiation oncologist, as the most qualified observer to detect and initiate management of post-irradiation tumor activity or sequelae in normal tissues, must be involved in the post-treatment follow-up program. Early detection of post-treatment tumor activity may permit additional treatment, which may be curative. Early detection and treatment of radiation-induced sequelae may avoid serious problems later.

VI. Quality Assurance of Radiation Therapy

The purpose of a Quality Assurance Program is the objective, systematic monitoring of the quality and appropriateness of patient care. Such a program is essential for all activities in Radiation Oncology.

The Quality Assurance Program should be related to structure, process and outcome, all of which can be measured. Structure includes the staff, equipment and facility. Process covers the pre- and post-treatment evaluations and the actual treatment application. Outcome is documented by the frequency of accomplishing stated objectives, usually tumor control, and by the frequency and seriousness of treatment induced sequelae.

The Director of Radiation Oncology is responsible for the organization and supervision of the departmental Quality Assurance Program.

Periodic (at least monthly) audits of recently completed charts by designated reviewers using appropriate screens (check lists) should be reported to the departmental Quality Assurance Committee. All identified problems should be discussed and recorded and a remedial action plan instituted. Requirements of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the Nuclear Regulatory Commission (NRC) should be fulfilled.

Components of a Quality Assurance Program for Radiation Oncology are summarized in the following:

6.1 Equipment

Minimal requirements for equipment include: 1) at least one supervoltage/ megavoltage teletherapy unit, with an energy exceeding 1 MV. The distance from the source to the isocenter must be at least 80 cm; 2) access to an electron beam source or a low energy Xıy unit; 3) appropriate brachytherapy equipment and sources for ıtracavitary and interstitial treatment; 4) adequate equipment to alibrate and measure dosimetric characteristics of all treatment units ı the department; 5) capability to provide appropriate dose distribu-on information for external beam treatment and brachytherapy; 6) quipment for accurate simulation of the treatment units in the epartment; 7) field-shaping capability; and 8) access to CT scanning apability (advisable).

.2 Programs

Minimal programs include: 1) calibration of equipment and ıeasurement of radiation beam characteristics to assure accurate and eliable delivery of the ionizing radiations; 2) charting systems for ecording treatment doses; 3) accurate calculation of doses and dose istributions, checks of dose calculations and ongoing reviews of ccumulating doses; 4) devices for prevention of mechanical injury ıf the patients or personnel by the treatment units or accessory quipment; 5) surveillance of the wearing, reading and recording of nformation from individual film badges; 6) systematic inspection of nterlocks; 7) routine leak testing of sealed radioactive sources; 8) ıvailability of safety equipment and use of personnel and patient afety procedures when fluoroscopy and sealed radioactive sources ıre used; 9) instruction in safe work habits and pertinent new levelopments; and 10) regular maintenance and repair of equipment.

5.3 Facilities

It is necessary that ramps, doorways, halls and lavatories ıccommodate wheel chairs, walkers and litters (except for lavatories). There should be holding areas for patients on litters or in beds. The internal environment should provide adequate lighting, ventilation and temperature control. Emergency procedures for fires and other catastrophes should be in place and understood by personnel.

6.4 Patient Evaluation and Treatment

All components of the evaluation of the patient and his/her cancer must be documented in the patient's Radiation Oncology Record. The format, which should facilitate care of the patient in the department, usually includes: a general information sheet listing the names of pertinent relatives, follow-up contacts, referring and family physicians and persons to notify in an emergency; initial history and findings on physical examination; reports of the pathology examinations, laboratory tests, diagnostic imaging studies and pertinent operations; photographs and anatomic drawings; medications currently used; correspondence with physicians and reimbursement organizations; treatment set-up instructions; daily treatment logs; physics, treatment planning and dosimetry data; progress notes during treatment; summaries of treatment; and reports of follow-up examinations.

It is essential that these radiation oncology records be maintained and secured in the department separate from hospital and clinic records to insure ready access at any time for a variety of purposes. Lack of immediate access to patient data can disrupt daily activities in the radiation oncology department. For example, all current and previous treatment data and the treatment plan, with any recent changes, must be available to the radiation therapy technologists each day when the patient is set up for treatment, before the beam is activated. Inasmuch as patients may be treated every 10–15 minutes throughout the day on each megavoltage unit, lack of immediate availability of data on a specific patient would result in chaos. In addition, radiation oncologists, who are on-site and thus "available", frequently receive unscheduled inquiries about patients being treated or those whom have been treated. Copies of pertinent data generated in the department, such as the initial consultation report, the summary of treatment and reports of follow-up visits must be included in each patient's hospital chart to be available to others throughout the medical center.

; Informed Patient Consent

Prior to the initiation of any patient management program, the tient must give valid consent for the actual treatment and related ivities such as photography of the face or treatment portals. If the tient is not mentally competent, consent must be obtained from a gally qualified representative. Each radiation oncology center ould have a methodology to explain to the patient, or proper presentatives, the patient's status, treatment alternatives with their asonable objectives and possible sequelae and the consequences of treatment. Informational materials, such as brochures, tape recordgs, video presentations and identification of available support rvices, may help the patient to understand and consequently to mply. If possible, explanations should be in the language preferred d best understood by the patient.

5 Treatment Planning Data

All data used in planning the specific treatment for a patient ould be immediately available for review. These include: anatomic awings, copies of appropriate visual imaging examinations, radioaphs from simulation of treatment, computation of beams and dose atterns, reasons for the choice of a specific management program, eatment beam verification films, calculation of doses and dose stributions and records of special physical measurements.

7 Treatment Data

The centerpiece of the patient's radiation therapy record is the iarting of each treatment. These entries, which must be made at the me of each application of ionizing radiations, usually include the aily and cumulative doses through each field to the target and sites f special interest, such as the spinal cord, kidney or eye. For regular-shaped fields, doses should be calculated at several anaomic sites. Supporting data, such as the actual identifying number nd dimensions of each field, maximum dose to each field, consecutive number of the treatment, overall time since initiation of treatment and actual date, usually accompany the dose entries. In addition, there should be positive identification of the equipment used, any treatment aids, the responsible radiation oncologist and referring physician. A written prescription, signed by the responsible radiation oncologist, should include daily and total doses to a specific site (stated depth or isodose contour) in a definite overall time, number of fields to be treated daily and the pattern of application (number of treatments per week). Photographic recording of the position of the patient during treatment, each treatment field and the patient's face help recall.

6.8 Assessment of Treatment

The results of treatment, with documentation of the status of the tumor and sequelae, must be assessed for every patient. Periodic evaluation of patients, in concert with other physicians including oncologists and the primary care provider, is an essential part of management. This is a responsibility shared by the patients and their physicians. A record of outcome by anatomic site, stage and histology should include all patients treated. Other information such as the presence of intercurrent diseases and other treatments is useful. Documenting and keeping these records current is necessary to insure high quality performance. This ever increasing burden of monitoring results should be simplified through the use of an automated data retrieval system.

6.9 Patient-Related Data

The following data should be maintained and kept current at every treatment facility: number of new and former patients seen in consultation; number of new and former patients treated; number of tumors treated at each anatomic site; number of simulations; number of treatment plans; number of treatment portals; whether the treatments were simple, complex or intermediate; number and types of brachytherapy procedures (interstitial implantations, intracavitary nsertions, surface and special applications); and number of post-reatment follow-up examinations.

Annual summaries of these data should be analyzed.

5.10 Assessment of Operations

Each facility should have ongoing programs to monitor opera-ions. Patient flow parameters, such as access to parking, promptness of patient scheduling, intervals from referral to consultation and nitiation of treatment, patient treatment throughput per unit time, must be assessed so that deficiencies can be corrected.

5.11 Medical Radiation Physics

The ultimate objective of Medical Radiation Physics activi-ies is to assure the delivery of high quality radiation therapy. These activities include active participation in: treatment planning; consul-ation and educational activities aiding the radiation oncologists and other staff; decisions on the purchase of equipment; and activities that assure that all radiation equipment and sources are operated and handled safely in order to provide adequate protection of staff, patients and the general public.

The Quality Assurance Program in Medical Radiation Phys-ics must be developed and monitored by a qualified medical radiation physicist. Necessary quality control of the physical components of radiation therapy includes: 1) assurance of proper, accurate and safe function of all treatment units and simulators; 2) procurement and storage of radioactive sources, and monitoring the proper function of brachytherapy applicators; 3) treatment planning with computer support; 4) monitoring of dosimetry, calibration and beam character-istics; and 5) surveillance safety of patients and personnel. These activities are outlined in Tables VI–1 to VI–4.

The success of radiation therapy is dependent on the accuracy of delivery of specified doses to selected targets, both in tumors and normal tissues. The margin for prevention of serious error may be slight. Therefore, the Medical Radiation Physicist must be provided with adequate personnel and equipment to accomplish these impor-tant tasks.

TABLE VI–1
Quality Assurance: Treatment Machines and Simulators

1. **RADIATION SURVEY**

2. **MECHANICAL SPECS. AND ALIGNMENT**
   - a. mechanical isocenter
   - b. light field (5x5 cm, 10x10 cm, 30x30 cm)
   - c. collimator rotational and cross hairs alignment
   - d. patient support assembly — 1/rotational
     2/vertical
     3/horizontal
     4/lateral
   - e. gantry rotation range and speed
   - f. gantry rotation alignment
   - g. laser localizer alignment

3. **RADIATION ISOCENTER**
   - a. alignment of collimator rotational axis
   - b. radiation beam and axis of gantry rotation
   - c. light field and radiation field coincidence
   - d. distance indicator

4. **X-RAY BEAM PERFORMANCE**
   - a. field flatness
   - b. field symmetry
   - c. photon beam symmetry vs. gantry angle
   - d. photon beam energy
   - e. dosimetry reproducibility and linearity
   - f. arc therapy

5. **ELECTRON BEAM PERFORMANCE**
   - a. electron beam flatness
   - b. electron beam symmetry
   - c. electron field symmetry vs. gantry angle
   - d. depth ionization
   - e. X-ray contamination
   - f. dosimetry reproducibility and linearity

TABLE VI-2
QUALITY ASSURANCE: TREATMENT PLANNING

		Quality Assurance Action
DIAGNOSTIC PATIENT DATA ACQUISITION	Diagnostic X-ray Nuclear Medicine, Ultrasound	Image quality assurance procedures are established in Diagnostic Departments.
	CT, MRI	Special procedures relating to therapy.
	Simulator	Image quality and mechanical integrity.
TREATMENT DECISION, TUMOR LOCALIZATION	Data synthesis, Contours Delineation of target volume and sensitive organs	Clinical quality assurance. Accuracy of contouring equipment. Simulator quality assurance
COMPUTATION OF DOSE AND DOSE DISTRIBUTION	TAR and/or other dose concepts, Algorithms Computer Fieldshaping Independent checks of calculations	Data verification for individual machines. Accuracy of calculational methods. Input-output devices of computer. Documentation of dose distribution data and calculational procedures.
IMMOBILIZATION BLOCKS AND WEDGES	Immobilization Devices, Mould Materials and Block Cutters	Frequent alignment and stability checks. Personnel safety in regard to material toxicity (lead, cadmium, tin, etc.) and shop procedures. Patient Safety.
TREATMENT VERIFICATION	Port film Verification	Field delineation and adequacy of tumor coverage (physicians should sign films). Image quality.
	Patient Charts - Routine checks	Dose summations and treatment prescriptions.
	Equipment Log Books	Adequate calibration records. Machine problems and performance.
	Patient Dosimetry	Dosimetry and equipment verification. Dosimeter placement. Analysis and reporting of results.

TABLE VI-3
QUALITY ASSURANCE: DOSIMETRY

iodic Calibration → NBS
osimeters → Local

e Intercomparisons between Institutions

chytherapy Source Calibrations

neration of Beam Data → When Commissioning Equipment
→ After Major Repairs
→ Periodically

iodic Constancy Checks of:

d Flatness e Distributions	Equipment →	Scanning Devices, Film
ntral Axis ibrations	Equipment →	Ionization Chambers
ient Dose rification vivo asurements)	Equipment →	TLD or Other Dosimeters

TABLE VI-4
QUALITY ASSURANCE: RADIATION SAFETY

PERSONNEL DOSIMETRY

- Calibration of Dosimeters by Suppliers: Instrument calibration; Source calibration
- ↓ Calibration Checks by User: Instrument calibration; Source calibration
- ↓ Distribution and Use of Badges
- ↓ Record Keeping and Reporting

RADIATION SURVEYS

- Consult facility design for origination of the beam relative to permanent attenuating objects
- Instrument Calibration NCRP Report #57 ICRU Report #20
- Source Calibration NCRP Report #41
- Interlock Check
- Radiation Surveys NCRP Reports 10, 33, and 49
- Restriction of beam orientation
- Workload
- Occupancy factor controlled vs. uncontrolled areas use factor
- Results for Different Operating Conditions: Exposure rate vs. location; Corrective measures

RADIOACTIVE SOURCE HANDLING

Facility:	Storage: Shielding, inventory Work area: Shielding, handling instruments Transport: Shielding, carrier design
Maintenance:	Cleaning, Sterilization, Leaktests, Disposal
Usage:	Patient rooms: Recovery, transport, ward Insertion: Shielded storage -- transport Removal: Patient survey, source counting, handling instruments Personnel monitoring
Training of Personnel:	M.D.'s, Nurses, Other
Emergencies:	Source Breakage, Loss of source } { Procedures, monitors, call list

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VII. Criteria for Utilization of Equipment and Facilities

An analysis of utilization of radiation therapy is the usual asis for documenting the need for additional, new or upgraded cilities and equipment and additional or different personnel. This is complex process which may be influenced by departmental, institu-onal, regional, economical and political considerations.

.1 General Guidelines

Appropriate numerical guidelines relate the numbers and pes of patients managed, the complexity of treatments, personnel, quipment and facilities. These guidelines may be modified by filiations between radiation oncologists and between treatment enters, accessibility of radiation therapy facilities to patients, limita-ons of existing equipment, transferability of patients between treat-ent facilities and financial agreements between medical centers. uch guidelines may change in time as technology and practice volve.

.2 Guidelines for Equipment Utilization

a. A realistic load for a megavoltage unit is about 6,500 standard treatments (equivalent simple treatment visits or ESTVs)* per year. This approximation is based upon an average of four patients treated hourly for 7 hours daily, 5 days per week, 51 weeks per year with allowances for double time for initial set-ups of five patients starting treatment per week, for verification films and other checks once weekly on 50% of patients being treated and for equipment maintenance or repair one day per month.

*Equivalent Simple Treatment Visit (ESTV)—The time required, usually about 15 minutes, for e uncomplicated set-up and treatment of a patient on a modern megavoltage unit.

This can be calculated as follows:

4 standard treatments/hr x 7 hr/day x 5 days/wk x 51 wks/year	=	7,140
less double time for initial treatment of 5 patients/week	=	260
less one day per month down time for equipment maintenance and repair (28 patients x 12 days)	=	336
patient treatments per year per unit	=	6,544

The 7-hour-daily patient treatment schedule allows for equipment quality assurance procedures, warm-up time for a linear accelerator, room preparation and clean-up, and other support activities, which in total with actual treatment comprise an 8-hour work day.

As the proportion of patients requiring multiple treatments per day (hyperfractionation) or complicated treatment techniques, such as total body irradiation, total nodal irradiation or irradiation while bedfast or anesthetized increases, the number of patients treated per unit time and the total number of treatments on each apparatus will decrease. Thus, at many major referral and university medical centers, the number of treatments per megavoltage unit may be closer to 5,000 per year.

b. If it is assumed that approximately 50% of patients will be treated for cure (30–40 increments) and 50% for palliation (10–20 increments), then about 250 patients can be treated on each megavoltage unit annually.

Patients treated for cure:		
125 patients x 35 Rx (average)	=	4,375
Patients treated for palliation:		
125 patients x 15 Rx (average)	=	1,875
Total		6,250

However, if the ratio changed to 60% of patients treated for cure and 40% treated for palliation, only 200 patients could be treated per megavoltage unit annually. Therefore, the percentage of patients treated for cure at a given institution is a major determinant in the capacity of each treatment unit.

A treated patient refers to a single course of treatment for a specific disease. If a patient returns for additional courses of treatment for new problems related to the initial cancer or to a different cancer, this is considered an additional work unit (number of patients treated). Inasmuch as the effort per patient varies widely, it may be of value to subclassify the patients by the complexity of treatment. (See Section 7.2 d.)

c. One megavoltage radiation therapy unit should serve a population of approximately 120,000 people. This is based on the assumption that 4.1 newly diagnosed cancers will be detected per year per 1,000 people. This frequency should be adjusted for regional factors. For example, in one state the reported frequency of newly diagnosed cancers has been 4.9 per 1,000, while in another it has been 1.9 per 1,000. If 50% of all patients with cancer receive radiation therapy, then a population of 120,000, which will produce about 492 newly diagnosed cancers at 4.1 per 1,000, will provide about 245–250 patients with cancers who will receive radiation therapy.

d. Adjustments to the above criteria must be made for: 1) dedicated special- purpose treatment units, such as for particle radiation therapy; 2) specialized procedures of limited but important application, such as total body irradiation (TBI), stereotaxic radiosurgery and intraoperative radiation therapy; and 3) patients who are difficult to handle such as infants and those in beds.

Allowances for the complexity of treatment can be based on current CPT–4 data. Simple, intermediate and complex radiation treatments are defined as follows:

<u>Simple</u> – single treatment site, single treatment field or parallel opposed fields with no more than simple blocks;

<u>Intermediate</u> – two separate treatment sites, three or more fields to a single treatment site, use of special blocking;

<u>Complex</u> – three or more treatment sites, tangential fields with wedges, rotational or arc techniques or other special arrangements, complex blocking (i.e., mantle and inverted Y fields).

The basic unit, one Equivalent Simple Treatment Visit (1 ESTV), requires up to 15 minutes on a modern megavoltage teletherapy unit. This includes time for portal filming. An Intermediate Treatment Visit can equal 1.1 ESTVs and most Complex Treatment Visits can equal 1.25 ESTVs.

Special consideration is required for patients needing more time than usual and for use of highly specialized treatment techniques. Thus, for children under 5 years of age, the ESTV can be multiplied by 2, and for most patients in beds the ESTV can be multiplied by 1.2.

For the increased time required for special techniques, supplemental ESTVs can be added for each visit:

Total body irradiation (photons or electrons)	Add 4.0 ESTVs
Hemi-body irradiation	Add 2.0 ESTVs
Intraoperative radiation therapy	Add 10.0 ESTVs
Particle radiation therapy	Add 2.0 ESTVs
Dynamic conformational radiation therapy with moving gantry, collimators and couch	Add 1.5 ESTVs
Limb salvage irradiation at lengthened SSD	Add 1.0 ESTV
Additional field check radiographs	Add 0.5 ESTV
Stereotaxic radiosurgery	Add 3.0 ESTVs

e. Types of Equipment Required

Patients treated in facilities, which are utilized for curative treatment, should have access to at least two megavoltage units, either on-site or through working agreements. One of these megavoltage units should provide photons of low energy (^{60}Co or 1–6 MV X-rays) and the other, photons, of at least 10 MV and electron energies to at least 12 MeV. Alternatively, a dual-modality, dual-energy accelerator might be sufficient if the lower X-ray energy is 4–6 MV and the highest electron energy is at least 12 MeV. In larger facilities, there should be at least one high energy (10 MV or above) unit to every 2 or 3 lower energy (Co–60 teletherapy, 4–6 MV linear accelerator) units depending on work load, types of patients and tumors treated and availability of expertise and supporting resources.

The increasing use of high energy electron beams as a component of treatment, such as for "boosting" the excision site in the intact breast, reducing the dose to the heart when treating the internal mammary nodes, irradiating the chest wall following mastectomy, treating posterior cervical nodes over the spinal cord or "boosting" the dose to intraoral and pharyngeal tumor sites, requires access to this capability in each facility where curative treatment is attempted. It is unreasonable, and possibly dangerous, to transfer patients between unrelated facilities in order to provide access to electron beam therapy because the necessary coordination of the several components of radiation therapy of a specific patient becomes unlikely. It is unrealistic to assume that all patients needing electron beam therapy will be specifically referred to an "outside" facility for that purpose. For the same reason, brachytherapy must be available so that all components of a patient's treatment can be integrated by the responsible radiation oncologist. Transfer of a patient from one facility to another during a course of radiation therapy is ill-considered because the chances for error and mismanagement are increased. Also, such disruption of care increases the cost to the patient because of duplication of effort, such as resimulation, additional reviews of records and creation of new records. In order to reduce the need to transfer patients or the temptation to treat patients with a less-than-optimal modality, the purchase of a dual-energy, dual-modality treatment unit should be considered. Despite the above concerns, in rare cases it may still be necessary to provide part of a patient's treatment at a remote facility, where expensive special-purpose treatment equipment is available.

Dislocation of a patient from an organized continuum of care for other reasons, such as an arbitrary geographical or institutional distribution of equipment, should be resisted by both patient and physician. In the past, the use of ill-conceived formulas to geographically distribute facilities and radiation treatment units fostered mediocrity at the expense of programs successful because of high quality performance. Referral of patients to facilities demonstrating high quality service should be supported. Administrative allocation of patients to facilities because they are under utilized promotes neither good care nor cost effectiveness.

f. Efficient Use of Resources

The high cost of an adequate radiation oncology facility generates interest in efficient use. One possibility is operation for more than a single standard work shift. Such an extension of the current conventional period of operation can be supported only if the quality of patient care is uniform throughout the entire work period. This implies comparable availability to all patients of personnel, including physicians, medical radiation physicists, nurses, technologists, receptionists and other support staff and of all services throughout the medical center, including patient billing, laboratories and administrative support. It must be realized, however, that any cost savings are likely to be less than apparent, since the equipment will wear out more rapidly and need to be replaced sooner.

7.3 Criteria for Equipment Replacement

Radiation treatment units require replacement when they become technologically obsolete or worn out. The average life of a modern megavoltage unit (linear accelerator, Co teletherapy unit) has

:en 8–12 years if: the equipment has been properly maintained; placement parts have been readily and economically available; and e operational characteristics and mechanical integrity have met :rformance and safety standards.

Beyond its useful working life, a megavoltage therapy unit :eds to be withdrawn from clinical service unless it can be upgraded warranty status and is not technologically obsolete. This periodic :placement and renovation of equipment is necessary not only for uality care, but for patient and personnel safety and efficient economical operation. Equipment replacement must be justified on epartmental and institutional, not geographical or political, needs.

.4 Criteria for Additional Equipment

The need for additional radiation therapy equipment in a pecific facility should be based upon an increasing number of atients requiring treatment, the changing complexity of treatment or ddition of a new specialized service.

Additional megavoltage equipment needs to be considered when:

1. utilization consistently exceeds the level of patient service defined in Section 7.2 (250 new patients treated or 6,500 equivalent simple treatment visits (ESTVs) annually per megavoltage unit);
2. the patient characteristics or tumor types require an increased complexity of treatment, i.e., electron beam "boosts" in breast conservation programs;
3. new techniques requiring more time per patient, i.e., total nodal or whole body irradiation, intraoperative irradiation and multifractionation of the usual daily dose increments, are introduced; and
4. there is an increased commitment to clinical research and teaching.

7.5 Simulators

a. All modern radiation therapy facilities should have access to at least one simulator, regardless of the number of patients being treated. The need for more than one simulator in a facility can be estimated from the following:

If a simulation, which requires about 60 minutes for an ambulatory, cooperative patient, is designated as an Equivalent Simple Simulation Visit (1 ESSV), the relative values of other simulation procedures can be allocated as follows:

Mantle field	Add 0.5 ESSV
Limb salvage techniques	Add 0.5 ESSV
Intact breast techniques with 3 fields	Add 0.5 ESSV
Extended fields at increased SSD	Add 0.5 ESSV
Conformal techniques	
for each set-up in excess of 3 fields	Add 0.3 ESSV
for dynamic motion (collimator, gantry, couch)	Add 1.0 ESSV

In general, one simulator can service 2–3 megavoltage treatment units.

b. Simulators, like megavoltage treatment units, need to be replaced or renovated when they become technologically obsolete, worn out, unsafe or inaccurate. Currently, simulators based on cross-section anatomy, rather than conventional orthogonal projections, are proving very useful and may become an important component of simulation.

7.6 Dedicated Special-Purpose Units

Recent development of sophisticated treatment delivery and planning systems have required the availability of special-purpose ipment. For example, three-dimensional treatment planning and simulation require direct access to CT units.

Certain treatment capabilities are not needed in every radia- therapy facility but should be available to all patients. Such units, ich can be considered regional and sometimes national resources, uld be considered separately when assessing equipment and sonnel requirements.

Examples are heavy particle accelerators, intraoperative ra- tion therapy units, stereotaxic radiation devices and special perthermia equipment.

Inasmuch as the proper clinical use of these technologies is certain, equipment and personnel needs have not been determined.

VIII. Characteristics of Clinical Programs

To enable the best possible management, patients must have convenient access to radiation oncologists and facilities where there are an adequate complement of qualified personnel and state-of-the-art equipment. Decisions about the care of patients should be based on clinical need and not compromised by the lack of immediately available resources.

To provide adequate management of patients, radiation oncology programs may include more than a single facility, several physicians and physicists and a range of skilled personnel. Necessary cooperation between personnel at separate facilities may be based on formal or informal relationships.

8.1 Program Structure

The structure of any radiation oncology program is based on a complex interaction of factors such as: needs of the patient population; demographic characteristics of the regional population; geographic relationships; scientific, educational and service needs; and community and special interests. A single type of organization will not function optimally in all situations; therefore, alternatives are necessary.

Possible structures include:

1) independent, self-contained centers;
2) conjoint centers with affiliated units of varying autonomy contributing to the overall function; and
3) regional networks of units organized for special purposes such as clinical research and education.

8.2 Personnel

The most important component of any program is the personnel. Requirements for various skills will vary with requirements for

itient service, education programs, research and community inter-
its. (See definitions in Glossary XI).

.2.1 Guidelines for Patient Service

Guidelines for minimum personnel necessary for good patient are are listed in Tables VIII–1 and VIII–2. Personnel requirements ıay vary somewhat related to specific needs of the treatment program.

.2.2 Guidelines for Academic Programs

In addition to personnel for patient management, academic rograms have additional needs commensurate with requirements for eaching, research and development of advanced technology. For xample, a full-time academic radiation oncologist may have less han a 50% time commitment to patient management. Therefore, the atio of physicians to patients treated would become one for 125 patients irradiated annually. Similar academic commitments increase he number of physicists required. For teaching, research, technology levelopment and ever increasing quality assurance responsibilities, he compliment of physicists could easily be at least double the ıumbers listed in Table VIII–1.

In addition, administrative requirements further reduce the ratio of physicians and physicists to patients treated.

Research and education activities need to be financially supported by means others than direct patient revenues. However, many of the administrative activities relate to patient care, particularly as outside regulatory and reimbursement agencies become involved.

Personnel, other than physicians, physicists, radiation therapy technologists, nurses and dosimetrists, required for the effective operation of a radiation oncology clinic include: an administrator; specially trained secretaries; medically trained transcriptionists; a receptionist; special duty clerks; an orderly; financial and personnel supervisors; a maintenance engineer and/or electronics technician; block/mold room technologist; a data manager; a dedicated social worker; and a dietitian. Personnel capable of maintaining complex radiation therapy units, such as linear accelerators and simulators, and physics equipment, must have skills usually not found in general biomedical electronics groups. Therefore, these people need to be specifically recruited and assigned to the radiation oncology facility. Programs with 2 or more megavoltage accelerators may require dedicated maintenance personnel.

8.3 Equipment

8.3.1. External Beam Treatment Units

A variety of equipment produces beams of ionizing radiations for therapy. These sources are electronic and radioisotopic. Their characteristics are summarized in Table VIII–3.

Superficial and orthovoltage X-ray therapy units are used to treat primary and secondary tumors on or near the body surface. These include cancers of the skin, eyelid, oral mucosa (per oral application through a cone) and uterine cervix (transvaginal application through a cone). The desired characteristic is maximal dose distribution on the surface with rapid fall off of dose with increasing depth in underlying tissue. For these reasons (lack of skin sparing and rapid fall off of dose), these X-rays are not suitable for treating deep seated tumors.

Accelerators (linear accelerators and microtrons) of varying energies and configurations have different clinical uses. All modern accelerators should be functionally reliable with an X-ray source that is isocentrically movable about a patient and should have an output adequate for treatment with the source at a distance of 80–100 cm from the patient. Low energy accelerators produce 4–6 MV photons, but usually do not have electron beam treatment capability. They have uses similar to those of ^{60}Co teletherapy units. High energy accelerators produce photons above 10 MV and usually have the capacity to produce a range of therapeutically useful electron beams. Some of these high energy accelerators also have a second photon beam of lower energy (dual- energy unit), thus increasing the versatility of the equipment. This is particularly useful in small facilities with 1–2 megavoltage units. As noted previously, large clinics may have one high energy accelerator for every 2–3 low energy units. This distribution may be more cost effective than using only dual-energy accelerators. However, if electron beams are frequently used, it is advisable to have access to at least two sources in case of equipment breakdown.

Medical betatrons provide high energy photon and electron beams. Although these generators are reliable, low dose output, limited field size and cumbersome motions of the treatment head limit the number of patients treated daily. These units are no longer manufactured.

Microtrons are electric generators similar in principle to linear accelerators but with magnetic bending of the electron paths into circular orbits. The microwave power source is either a klystron or a magnetron. The beam transport system is relatively simple. A single microtron may supply beams to several treatment rooms. Although the first clinical microtron was described in 1972, few have been used.

Cobalt–60 teletherapy units generate photons from the decay of a radioactive isotope. A modern isotope source, with a diameter of 2.0 cm or less, can produce an output of more than 150 cGy per minute at a source to axis distance (SAD) of 80 cm, the *minimum* acceptable distance for clinical teletherapy. The artificially activated ^{60}Co source, which has a half-life of 5.3 years, requires periodic (usually about every 4 years) replacement in a busy clinic.

Teletherapy has been attempted with Cesium–137 sources. Because of the low specific activity of this isotope, the sources often have been larger than 2.0 cm in diameter, leading to an unacceptable beam penumbra. The source-to-patient distance often has been reduced to less than 80 cm in order to increase the radiation output at the site of interest. For these reasons, Cesium–137 teletherapy is *not* acceptable for modern clinical radiation therapy.

It is important that Cesium–137 teletherapy units, Cobalt–60 teletherapy units designed for use at less than 80 cm SAD, old betatrons and other electronic units, i.e., van de Graaf generators, unsuitable for modern clinical use, *not* be counted in any regional clinical radiation therapy equipment survey.

8.3.2 Simulators

Any program in which curative radiation therapy is offered must have access to a modern simulator capable of precisely reproducing the geometric relationships of the treatment equipment to a patient. This simulator must produce high quality diagnostic radiographs. The availability of fluoroscopy increases the usefulness and the patient throughput. Use of fluoroscopy requires special personnel training and careful use because of the radiation hazards. Photon beams of megavoltage therapy units are unsuitable for good quality imaging of anatomic structures within the treatment volume and so do not adequately substitute for a simulator. If there are additional simulators in a department, these may be adequate with only the radiographic, and not the fluoroscopic, capability.

Computerized tomography and magnetic resonance imaging are being used increasingly in radiation treatment planning. If there are no dedicated scanners in the radiation oncology department, it is essential that there be a definite time allotment on the CT and MR scanners in the medical center or clinic to facilitate treatment planning. In a large department, such time requirements become the equivalent of a dedicated imaging unit.

8.3.3 Treatment Planning/Dose Computation Equipment

The calculation of doses at points within the irradiated volume of the patient is an integral part of the delivery of radiation treatments. Curative treatments require careful planning, including an evaluation of several alternate treatment approaches. Thus, it is essential that all radiation therapy facilities have access to modern computerized treatment planning systems. While for small facilities (i.e., < 300 atients/year) it might be adequate to subscribe to a time-sharing ystem located in a large medical center, having a dedicated system rithin the department has proven very valuable for providing high uality care. A computerized treatment planning system should, as a ninimum, provide the capability of simulation of multiple external eams, display isodose distributions in more than one plane and erform dose calculations for brachytherapy implants. It is highly esirable that the system has the capability of performing CT based eatment planning.

.4 Support Services

Radiation oncology is a clinical service which, to be effective, ust be a full participant in cancer activities in the medical center or e private office complex.

.4.1 Hospitalization of Patients

Although about 85–90% of patients treated daily in a radiation ncology facility are outpatients, more than 10–15% require hospital-zation at some time for a variety of reasons. Many must be in the ospital while implanted radioactive material is in place, because of oth public safety concerns and the need for close medical observa-ion and provision of relief of symptoms. Others are hospitalized ecause of the adverse effects of treatment or the tumor itself. Occasionally, a concurrent illness forces hospitalization. When ospitalization becomes necessary during or after radiation therapy, he radiation oncologist may be the admitting and attending physi-ian, supervising the medical aspects of inpatient care and involving onsultants as necessary. In this capacity, the radiation oncologist erves in the same role, and should meet the same standards, as any ther admitting/attending physician. This requires admitting privi-eges and hospital staff membership.

8.4.2 Access to Operating Room

The radiation oncologist must have access to the operating room for a range of brachytherapy procedures. The radioactive materials for interstitial or intracavitary applications need to be placed in appropriate applicators either by or under the direct supervision of radiation oncologists and medical radiation physicists. Inasmuch as this preparation usually is done in a special room in the radiation oncology department, safe transport of the radioactive materials to and from the operating room or patient's room also is their responsibility. Inasmuch as radiation oncologists are responsible for patient selection, applicator selection and preparation and results and sequelae of brachytherapy, it is essential that they participate in each procedure.

8.4.3 Hospitalization of Patients During Brachytherapy

During hospitalization for brachytherapy, patients must be under the control of the responsible radiation oncologist. Procedures, which might alter the position of the applicators, and medications and diet, which may influence the patient's tolerance to the procedure, must be closely controlled and monitored. Patient and personnel radiation safety measures must be firmly established, controlled and monitored by the responsible radiation oncologist, the medical radiation physicist and the radiation protection organization of the medical center.

8.4.4 Clinical Facilities

The clinical facility must be designed to accommodate a large number of outpatients and a limited number of inpatients, many of whom are in hospital beds or wheelchairs. Inasmuch as 85–90% of the patients are outpatients, who may have appointments 5 days per week for several weeks during treatment, it is important that the clinical radiation oncology facility be close to a parking area.

Reception and waiting areas may be designed to separately accommodate the patients being treated and the patients scheduled for consultation and follow-up examination.

An adequate number of examination rooms must be equipped for complete physical examinations, to include the head and neck and female pelvis.

It is useful to have a comfortable room where the physician may discuss the findings and the proposed management program with the patient and relatives.

A physician's work room, adjacent to the clinic examination rooms, allows review of charts and visual aids, discussion, dictation and phone use outside the immediate range of the patients.

A securable medication room for small quantities of narcotics may be useful.

A procedure room for the biopsy of a surface lesion, endoscopy, thoracentesis, and even intracavitary placement of applicators or interstitial sources of radioactive isotopes, extends the range of activities in the department.

The treatment planning area should be near the treatment rooms to promote necessary interchange between the physicians, physicists, technologists and dosimetrists.

A physics laboratory to support dosimetry and equipment calibration needs to be near the treatment units.

Access to a machine shop, for fabrication of unique items of equipment, and to an electronics shop, for maintenance of electronic equipment, saves time and money.

A room for fabrication of treatment aids and immobilization devices is necessary.

Facilities for the secure storage of radioactive brachytherapy sources are essential.

TABLE VIII–1
MINIMUM* PERSONNEL REQUIREMENTS FOR CLINICAL RADIATION THERAPY

Category	*Staffing*
Radiation Oncologist-in-Chief	One per program
Staff Radiation Oncologist	One additional for each 200–250 patients treated annually. No more than 25-30 patients under treatment by a single physician.
Radiation Physicist	One per center for up to 400 patients annually. Additional in ratio of 1 per 400 patients treated annually
Treatment Planning Staff	
Dosimetrist or Physics Assistant	One per 300 patients treated annually
Physics Technologist (Mold Room)	One per 600 patients treated annually
Radiation Therapy Technologist	
Supervisor	One per center
Staff (Treatment)	2 per megavoltage unit up to 25 patients treated daily per unit 4 per megavoltage unit up to 50 patients treated daily per unit
Staff (Simulation)	2 for every 500 patients simulated annually
Staff (Brachytherapy)	As needed
Treatment Aid	As needed, usually one per 300–400 patients treated annually
Nurse**	One per center for up to 300 patients treated annually and an additional one per 300 patients treated annually
Social Worker	As needed to provide service
Dietitian	As needed to provide service
Physical Therapist	As needed to provide service
Maintenance Engineer/Electronics Technician	One per 2 megavoltage units or 1 megavoltage unit and a simulator if equipment serviced "in-house"

*Additional personnel will be required for research, education and administration. For example, if 800 patients are treated annually with 3 accelerators, one ^{60}Co teletherapy unit, a superficial x-ray machine, one treatment planning computer, the clinical allotment for physicists would be 2-3. A training program with 8 residents, 2 technology students and a graduate student would require another 1-1.5 FTEs. Administration of this group would require 0.5 FTE. If the faculty had 20% time for research, a total of 5-6 physicists would be required.

**For direct patient care. Other activities supported by LVNs and nurses aides.

TABLE VIII-2

KEY STAFF FUNCTIONS IN CLINICAL RADIATION THERAPY

	KEY STAFF	SUPPORTIVE ROLE
. CLINICAL EVALUATION	Radiation Oncologist	
. THERAPEUTIC DECISION	Radiation Oncologist	
. TARGET VOLUME LOCALIZATION		
Tumor Volume	Rad. Oncologist & Physicist	Sim. Tech/Dosimetrist
Sensitive Critical Organs	Radiation Oncologist	Sim. Tech/Dosimetrist
Patient Contour	Physicist	Sim. Tech/Dosimetrist
. TREATMENT PLANNING		
Beam Data-Computerization	Physicist	
Computation of Beams	Physicist	Dosimetrist
Shielding Blocks, Treatment Aids, etc	Dosimetrist/ Mold Room Tech	Radiation Oncologist/ Physicist
Analysis of Alternate Plans	Radiation Oncologist/ Physicist	Dosimetrist
Selection of Treatment Plan	Radiation Oncologist/ Physicist/Dosimetrist	
Dose Calculation	Dosimetrist	Physicist
. SIMULATION/VERIFICATION OF TREATMENT PLAN	Radiation Oncologist/ Sim. Tech	Dosimetrist/ Physicist
. TREATMENT		
First Day Set-Up	Radiation Oncologist/ Dosimetrist Therapy Techs	Dosimetrist/ Physicist
Localization Films	Radiation Oncologist/ Therapy Techs	Dosimetrist/ Physicist
Daily Treatment	Radiation Therapy Tech	
'. EVALUATION DURING TREATMENT	Radiation Oncologist Nurse	Radiation Therapy Tech Social Worker Dietician
I. FOLLOW-UP EXAMS	Radiation Oncologist Nurse	Data Manager Social Worker Dietician

TABLE VIII-3

RADIATION THERAPY UNITS

Type of Equipment	Maximum Beam Energy MeV X or Gamma Rays	Maximum Beam Energy MeV Electrons	Characteristics
Superficial X-ray Units	0.1	—	High dose at surface Shallow penetration of X-rays
Orthovoltage X-ray Units	0.3	—	High dose at surface Moderate penetration of X-rays
Linear Accelerators			
Low Energy	4–6		Large field sizes High dose rates, skin sparing Sharp beam margins
High Energy	> 10	to 25	Good depth dose characteristics
Betatron	25–45	to 45	Small field sizes Low dose rates Good depth dose characteristics
Microtron	5–50	to 50	Similar to those of linear accelerator
Radioactive Isotope Unit			
Cobalt-60	1.2		Acceptable field sizes, dose rates and depth dose characteristics if SSD $\geq$ 80 cm Large penumbra

IX. Economic Issues

Until recently, the environment for reimbursement for radiation oncology was acceptance of "usual and customary" charges based on patterns developed over many years. This resulted in wide variations locally and nationally.

Major changes have recently occurred. In July, 1985, it became mandatory that Medicare billing utilize Current Procedural Terminology (CPT) for reporting medical services performed by physicians. Soon thereafter, the Health Care Finance Administration (HCFA) issued Transmittal 1200 redefining the concept of daily and weekly patient management. Shortly afterwards, a Resource Based Relative Value Scale (RBRVS), designed in the Harvard School of Public Health, was introduced for Diagnostic Radiology. This has been extended to Radiation Oncology.

A consequence of the use of RBRVS is that reimbursement levels for radiation oncology units will be similar whether hospital-based or free-standing. Likewise geographic variations will be reduced and eventually eliminated.

These changes are not designed to reduce high quality patient care, but they will require documented justification for new equipment, programs and personnel. Innovation and research necessary to improve the radiation treatment of patients with cancer may become more difficult to support.

In the immediate future, billing and reimbursement must be updated to current practices, and CPT and RVS codes must be properly related (a users guide has been issued by the American College of Radiology).

X. Conclusions

The primary goal of cancer management is to provide every patient with the best possible management regardless of constraints. Secondary goals include continuing improvement of treatment through the development of better methods and the training of personnel.

Radiation therapy is an integral component of the management of 50–60% of patients with cancer in the United States. To ensure maximum effectiveness and minimal treatment induced morbidity, the modality must be used as well as current knowledge and technology permit.

In this report, guidelines are proposed for optimal use based on standards for personnel, equipment, facilities and operations.

XI. Glossary

Accelerated Fractionation—The use of multiple daily increments, each equal to or less than a standard daily increment (i.e., 180–200 cGy), for an overall time which is shorter than standard.

Betatron—An accelerator first used for radiotherapy in the 1950s prior to the introduction of linear accelerators. Although X-ray and electron beams can be provided over a wide range of energies, the low dose rates and limited field sizes result in an unfavorable comparison with modern linear accelerators.

Brachytherapy—A method of treatment using sealed radioactive sources to deliver radiations at short distances by interstitial, intracavitary or surface applications.

Cancer—A term inclusive of a variety of malignant neoplasms; derived from the Latin word for crab.

Cesium–137—A radioactive isotope with a half-life of 30 years; emits gamma radiations with an energy of 660 keV most commonly used in intracavitary sources; found early use as teletherapy sources and in interstitial needle sources; sometimes used in remote afterloading brachytherapy.

Cobalt–60—A radioactive isotope with a half-life of 5.3 years; emits gamma radiations (1.17 and 1.33 MeV); used as a teletherapy source; found early use in interstitial and intracavitary needle sources; sometimes used in remote afterloading brachytherapy.

Cure—Actually implies complete restitution to predisease status; may be used for that situation when, after a disease-free, post-treatment interval, the survivors have a progressive death rate from *all* causes similar to that of a normal population of the same age and sex.

Dosimetrist—A member of the radiation therapy planning team who must be familiar with the physical characteristics of the radiation generators and radioactive sources used to treat patients; training and expertise necessary to generate and calculate radiation dose distributions, under the direction of the medical physicist and radiation oncologist, are necessary.

Electron—An atomic particle with a negative electric charge which may be accelerated to strike a target and produce X-rays or used collectively as a beam for treatment.

Gamma Rays—Electromagnetic (photon) radiations which are emitted from an unstable atomic nucleus; for example, gamma rays are emitted from Cesium–137, Cobalt–60 and Radium–226.

Hyperfractionation—The use of multiple daily increments, each considerably smaller than a standard daily increment, over a conventional period.

Hyperthermia—Elevation of the body temperature regionally (i.e., 42–45°C) or systemically (i.e., 41.8°C) resulting in direct cell killing and augmentation of the effects of other cytotoxic agents.

Interstitial Radiation Therapy—Sealed radioactive sources within special applicators placed in tissue in a preconceived pattern.

Intracavitary Radiation Therapy—Radioactive sources in closed containers placed in body cavities, i.e., uterus, vagina.

Ionizing Radiations—Radiant energy which is absorbed by a process of imparting its energy to atoms through the removal of orbital electrons.

Iridium–192—A radioactive isotope with a half-life of 74 days; emits gamma (300–600 keV) radiations; used in interstitial therapy; sometimes used in remote afterloading brachytherapy.

Linear Accelerator—A device in which particles (i.e., electrons, protons) can be accelerated to high energies along a straight path using microwave technology.

Linear Energy Transfer (L.E.T.)—A measure of the average rate of energy loss along the track of a charged particle, expressed as energy units per unit track length.

Medical Radiation Physicist—A professional with at least a master's degree and usually a Ph.D. in physics plus additional training and experience in diagnostic and/or therapeutic radiologic physics; most are certified by the American Board of Radiology or its equivalent.

Megavoltage Radiations—An ill-defined, frequently used term for ionizing radiations with energies equal to or greater than 1 MV.

Microtron—An electronic generator similar in principle to a linear accelerator but with magnetic bending of the electron paths into circular orbits; a single generator may supply beams to several treatment rooms.

Oncology—The study of tumors; no specific relationship to a medical discipline; applies to surgery, radiology, internal medicine, pediatrics and gynecology.

Orthovoltage X-rays—A term which applies to X-rays of insufficient energy to be "skin-sparing" or to avoid preferential absorption in bone; usually generated at 150–400 kVp; may be divided into superficial and deep X-rays, although often used interchangeably with deep X-ray.

Palliation—Relief or prevention of symptoms or signs caused by disease.

Penumbra—Those radiations just outside and adjacent to the full beam including components from incomplete beam collimation and scatter from the primary beam.

Radiation Dose—Energy imparted per unit mass of absorber at a specific site under certain conditions (absorbed d., threshold d., tumor d., depth d., permissible d.).

Radiation Oncologist—A physician with a special interest and competence in managing patients with cancer; minimal requirements include an M.D. degree, a year of general clinical training, three to four years of specialized training and certification by the American Board of Radiology or its equivalent.

Radiation Oncology—A clinical medical specialty with a specific involvement with tumors, particularly as they relate to treatment with ionizing radiations.

Radiation Oncology Nurse—A registered professional nurse who, as part of the radiation oncology team, provides appropriate direct intervention to aid the patient and family with problems related to the disease, treatment and follow-up evaluation; recommended minimal qualifications include a baccalaureate degree in nursing, two years experience in medical-surgical nursing and at least one year's experience in oncology nursing.

Radiation Therapy—Treatment of tumors and a few specific non-neoplastic diseases with ionizing radiations.

Radiation Therapy Technologist—A highly skilled professional who is qualified by training and experience to provide treatment with ionizing radiations under the supervision of a radiation oncologist.

Radioactivity—Emission of radiations from the breakdown of unstable nuclei which occurs naturally or is artificially produced.

Radionuclide—A radioactive form of a nuclide, which is any nuclear species of a chemical element capable of existing for a measurable time; often an isotope, with the same number of protons but a different number of neutrons. is referred to as a nuclide.

Simulation—Meaning to pretend; in radiation therapy, the precise mock-up of a patient treatment with radiographic documentation of the treatment portals.

Stereotactic Radiation Therapy—A method using three-dimensional target localization, which enables precise irradiation of small intracranial lesions.

Superficial X-rays—Minimally penetrating X-rays of low peak energy, generated by voltages in the range of 85–140 kV; used to treat lesions on the body surface.

Attachment 4

Table 3: 2019 Cancer Incidence and Mortality by County

	Incidence		Mortality	
	Cases	**Rate**	**Deaths**	**Rate**
North Carolina	62,434	477.4	19,963	151.8
Alamance	1,115	518.3	421	191.0
Alexander	230	428.6	81	148.4
Alleghany	69	307.0	38	169.3
Anson	170	524.3	64	186.6
Ashe	216	443.4	87	164.5
Avery	122	459.0	42	148.3
Beaufort	354	467.0	130	163.4
Bertie	122	420.7	56	190.3
Bladen	207	383.9	80	160.6
Brunswick	1,326	467.5	379	134.1
Buncombe	1,728	470.8	505	127.9
Burke	719	537.2	238	169.5
Cabarrus	1,226	518.5	307	135.8
Caldwell	642	529.7	209	170.2
Camden	44	321.1	19	131.9
Carteret	580	479.2	208	164.8
Caswell	193	544.7	65	167.9
Catawba	971	461.3	343	161.2
Chatham	520	429.7	182	134.1
Cherokee	226	381.7	102	163.4
Chowan	104	480.1	42	171.7
Clay	105	479.1	34	127.9
Cleveland	670	496.9	252	185.0
Columbus	345	423.5	154	183.2
Craven	671	493.3	253	178.4
Cumberland	1,362	411.2	535	167.8
Currituck	129	339.2	47	128.1
Dare	230	393.8	76	132.8
Davidson	1,109	480.1	420	177.1
Davie	301	481.7	120	176.4
Duplin	359	455.9	118	147.3
Durham	1,619	468.2	475	143.1
Edgecombe	346	467.4	137	178.6
Forsyth	2,164	460.6	729	155.1

Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. Census.

Cancers of the female breast and urinary bladder include in situ cases.

Brain and other central nervous system cancer excludes benign cases.

** cancer incidence rates for cell sizes with fewer than 16 cases of cancer and cancer mortality rates based on cancer deaths less than 16 are suppressed as they are not stable.

Rates are calculated using the bridged-race population estimates obtained from the National Center for Health Statistics available online at www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm#vintage2020.

Table 3 (continued): 2019 Cancer Incidence and Mortality by County

	Incidence		Mortality	
	Cases	Rate	Deaths	Rate
Franklin	411	452.5	131	146.0
Gaston	1,591	563.7	490	171.0
Gates	47	274.7	25	153.7
Graham	53	365.5	19	117.7
Granville	433	525.0	133	165.7
Greene	123	458.0	50	182.3
Guilford	3,191	497.2	932	146.1
Halifax	361	481.8	151	197.2
Harnett	653	455.3	227	166.2
Haywood	542	529.8	162	144.3
Henderson	1,012	510.0	295	139.8
Hertford	128	364.8	55	150.2
Hoke	205	400.4	69	136.4
Hyde	37	505.5	13	179.2
Iredell	1,187	526.2	339	152.7
Jackson	241	421.2	90	148.8
Johnston	1,157	491.9	335	155.3
Jones	79	533.7	24	154.5
Lee	394	506.5	120	147.9
Lenoir	465	592.3	141	166.9
Lincoln	585	492.7	199	162.7
McDowell	369	527.5	124	173.7
Macon	283	437.7	100	143.6
Madison	158	480.4	47	134.5
Martin	184	541.1	50	132.8
Mecklenburg	5,229	474.1	1,359	133.3
Mitchell	111	456.9	49	200.3
Montgomery	172	413.6	69	168.4
Moore	745	474.4	259	151.5
Nash	533	409.4	220	164.1
New Hanover	1,528	494.0	424	135.4
Northampton	155	447.7	53	156.3
Onslow	817	526.7	275	181.9
Orange	745	462.0	184	119.4
Pamlico	113	481.8	38	154.1

Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. Census.

Cancers of the female breast and urinary bladder include in situ cases.

Brain and other central nervous system cancer excludes benign cases.

** cancer incidence rates for cell sizes with fewer than 16 cases of cancer and cancer mortality rates based on cancer deaths less than 16 are suppressed as they are not stable.

Rates are calculated using the bridged-race population estimates obtained from the National Center for Health Statistics available online at www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm#vintage2020.

Table 3 (continued): 2019 Cancer Incidence and Mortality by County

	Incidence		Mortality	
	Cases	Rate	Deaths	Rate
Pasquotank	223	430.4	86	163.9
Pender	399	466.5	115	137.8
Perquimans	100	438.6	44	164.8
Person	262	444.3	92	146.5
Pitt	812	423.9	284	148.7
Polk	152	382.0	59	133.1
Randolph	1,011	523.9	318	163.5
Richmond	297	490.4	121	200.2
Robeson	671	430.6	283	181.8
Rockingham	743	543.4	244	177.1
Rowan	963	519.5	346	181.9
Rutherford	488	486.1	160	146.9
Sampson	387	471.7	153	179.1
Scotland	209	452.5	83	179.1
Stanly	479	552.7	146	164.3
Stokes	329	482.9	107	148.3
Surry	542	508.5	208	191.4
Swain	106	550.2	43	215.1
Transylvania	262	406.6	99	135.5
Tyrrell	28	551.8	10	**
Union	1,368	520.4	368	152.9
Vance	281	455.8	109	173.7
Wake	5,408	477.8	1,334	126.6
Warren	139	427.5	50	151.6
Washington	89	441.2	31	145.4
Watauga	258	393.2	88	128.4
Wayne	751	488.0	291	184.4
Wilkes	409	399.9	174	162.7
Wilson	499	455.8	169	148.0
Yadkin	252	464.6	92	161.7
Yancey	148	486.6	57	166.9

Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. Census.

Cancers of the female breast and urinary bladder include in situ cases.

Brain and other central nervous system cancer excludes benign cases.

** cancer incidence rates for cell sizes with fewer than 16 cases of cancer and cancer mortality rates based on cancer deaths less than 16 are suppressed as they are not stable.

Rates are calculated using the bridged-race population estimates obtained from the National Center for Health Statistics available online at www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm#vintage2020.

Attachment 5

County	Population as of July 1, 2010	Population as of July 1, 2015	Population as of July 1, 2020	Population as of July 1, 2025	Population as of July 1, 2030	Population as of July 1, 2035	Population as of July 1, 2040	Population as of July 1, 2045	Population as of July 1, 2050
Alamance	151,465	157,162	171,753	183,172	192,672	202,172	211,669	221,168	230,664
Alexander	37,183	36,590	36,464	36,715	36,722	36,730	36,738	36,748	36,755
Alleghany	11,120	10,915	10,909	11,165	11,222	11,282	11,339	11,397	11,453
Anson	26,777	24,599	22,054	21,326	21,185	21,126	21,103	21,095	21,092
Ashe	27,193	26,350	26,582	26,690	26,719	26,749	26,780	26,810	26,840
Avery	17,788	17,609	17,907	17,950	17,952	17,951	17,950	17,951	17,952
Beaufort	47,750	46,147	44,669	43,936	43,165	42,397	41,627	40,859	40,088
Bertie	21,197	19,537	17,905	16,293	15,386	14,479	13,572	12,663	11,754
Bladen	35,038	32,189	29,618	28,897	28,708	28,731	28,850	29,013	29,195
Brunswick	107,860	118,372	137,789	168,650	190,301	208,623	225,987	243,090	260,121
Buncombe	238,846	256,096	269,797	283,079	297,608	312,136	326,666	341,195	355,726
Burke	90,464	87,316	87,619	87,840	87,754	87,687	87,609	87,528	87,447
Cabarrus	178,757	199,455	226,641	250,522	274,023	298,190	321,726	345,669	369,446
Caldwell	82,940	81,110	80,620	81,183	81,250	81,258	81,260	81,258	81,259
Camden	10,000	9,984	10,385	11,540	12,252	12,692	12,963	13,130	13,232
Carteret	66,615	68,019	67,739	70,182	72,250	74,286	76,317	78,349	80,381
Caswell	23,727	23,120	22,736	22,051	21,572	21,095	20,624	20,152	19,684
Catawba	154,760	156,281	160,792	165,952	171,221	176,492	181,761	187,033	192,303
Chatham	63,836	69,102	76,544	82,774	89,167	95,958	102,379	108,977	115,545
Cherokee	27,415	27,344	28,852	29,810	30,867	31,925	32,982	34,039	35,098
Chowan	14,725	14,205	13,692	13,726	13,735	13,744	13,754	13,762	13,771
Clay	10,597	10,747	11,115	11,797	12,389	12,985	13,581	14,174	14,771
Cleveland	97,885	97,024	99,684	103,964	105,879	106,767	107,178	107,370	107,458
Columbus	57,855	54,489	50,580	49,375	48,209	47,042	45,878	44,715	43,549
Craven	104,123	102,048	102,266	102,307	102,518	102,595	102,624	102,635	102,639
Cumberland	327,275	329,843	335,970	347,401	349,450	349,915	350,017	350,040	350,047
Currituck	23,652	25,122	28,298	34,817	41,335	47,851	54,369	60,886	67,404
Dare	33,954	35,228	37,025	39,303	41,583	43,861	46,142	48,422	50,700
Davidson	162,803	163,650	169,178	176,800	184,106	191,413	198,719	206,025	213,330
Davie	41,231	41,207	42,802	45,158	47,495	49,831	52,169	54,505	56,841
Duplin	58,347	53,663	48,729	48,767	48,789	48,805	48,811	48,816	48,822
Durham	271,486	299,753	325,573	346,436	369,536	392,632	415,735	438,834	461,932
Edgecombe	56,498	52,420	48,820	45,963	43,055	40,148	37,241	34,336	31,430
Forsyth	351,434	366,725	382,944	393,717	409,296	426,056	443,136	460,305	477,496
Franklin	60,765	62,638	68,902	80,352	91,985	103,622	115,253	126,891	138,523
Gaston	206,194	213,902	228,264	245,067	253,731	263,460	273,091	282,724	292,357
Gates	12,126	11,091	10,476	10,153	10,047	10,012	10,003	10,001	9,999
Graham	8,846	8,355	8,024	8,083	8,105	8,117	8,117	8,117	8,121
Granville	57,674	58,071	61,059	64,233	67,873	71,514	75,153	78,793	82,432
Greene	21,240	20,685	20,461	20,120	20,120	20,119	20,120	20,120	20,120

County	Population as of July 1, 2010	Population as of July 1, 2015	Population as of July 1, 2020	Population as of July 1, 2025	Population as of July 1, 2030	Population as of July 1, 2035	Population as of July 1, 2040	Population as of July 1, 2045	Population as of July 1, 2050
Guilford	489,672	517,510	541,685	553,974	576,697	602,030	628,007	654,146	680,324
Halifax	54,411	51,003	48,581	46,508	44,375	42,243	40,110	37,977	35,845
Harnett	115,693	125,704	133,784	148,250	158,799	170,341	181,670	193,045	204,408
Haywood	58,895	59,805	62,146	64,073	66,044	68,014	69,985	71,957	73,927
Henderson	106,848	110,946	116,519	119,994	125,945	132,338	138,815	145,302	151,797
Hertford	24,716	23,419	21,516	19,079	18,366	17,653	16,939	16,226	15,513
Hoke	47,446	50,663	52,206	58,678	63,805	68,733	73,633	78,528	83,423
Hyde	5,796	5,262	4,572	4,385	4,120	3,864	3,617	3,379	3,156
Iredell	159,854	171,279	187,329	209,430	231,528	253,627	275,727	297,825	319,925
Jackson	40,354	41,186	43,163	44,050	45,843	47,637	49,430	51,226	53,019
Johnston	169,781	185,945	217,033	256,452	282,334	306,937	331,491	356,043	380,597
Jones	10,119	9,795	9,178	9,196	9,191	9,193	9,192	9,192	9,192
Lee	57,913	59,395	63,396	67,229	70,925	74,621	78,319	82,014	85,713
Lenoir	59,436	57,171	55,094	53,741	52,357	50,970	49,587	48,199	46,813
Lincoln	78,083	80,110	87,108	95,751	101,227	107,866	114,153	120,521	126,878
Macon	33,967	34,895	37,070	38,564	40,081	41,601	43,116	44,635	46,154
Madison	20,766	21,129	21,215	21,750	22,126	22,507	22,885	23,262	23,640
Martin	24,482	23,199	22,012	20,919	19,995	19,067	18,139	17,212	16,286
McDowell	45,053	44,462	44,591	44,772	44,774	44,775	44,774	44,774	44,774
Mecklenburg	923,344	1,035,479	1,117,834	1,206,758	1,303,123	1,402,073	1,501,251	1,600,393	1,699,526
Mitchell	15,504	15,054	14,895	14,775	14,580	14,394	14,211	14,032	13,860
Montgomery	27,659	26,447	25,742	25,738	25,737	25,736	25,737	25,736	25,734
Moore	88,517	92,545	100,024	111,848	123,613	135,321	146,972	158,565	170,097
Nash	95,782	93,505	95,546	95,399	95,361	95,348	95,341	95,340	95,338
New Hanover	203,092	215,383	226,077	244,233	259,215	274,199	289,182	304,164	319,147
Northampton	21,961	19,731	17,471	16,533	15,739	14,941	14,145	13,347	12,552
Onslow	186,891	193,610	204,798	216,897	228,959	241,019	253,077	265,138	277,197
Orange	134,010	141,265	148,911	154,040	161,272	168,428	175,508	182,514	189,448
Pamlico	13,082	12,611	12,291	12,191	12,016	11,838	11,662	11,486	11,310
Pasquotank	40,635	39,637	40,788	41,075	41,324	41,422	41,460	41,471	41,479
Pender	52,333	55,984	60,441	69,774	74,886	80,002	85,113	90,226	95,336
Perquimans	13,457	13,255	13,006	13,815	14,064	14,140	14,162	14,171	14,174
Person	39,374	38,793	39,163	39,846	40,156	40,356	40,489	40,574	40,631
Pitt	168,567	169,452	172,254	172,615	178,262	187,081	197,318	208,186	219,339
Polk	20,413	19,687	19,366	19,605	19,637	19,652	19,657	19,663	19,666
Randolph	141,958	142,252	144,346	147,820	151,192	154,566	157,940	161,313	164,684
Richmond	46,586	44,392	42,915	41,754	40,794	39,833	38,874	37,914	36,952
Robeson	134,066	125,709	116,500	118,089	119,335	120,065	120,492	120,742	120,890
Rockingham	93,648	91,438	91,147	92,033	92,040	92,041	92,040	92,040	92,040
Rowan	138,417	141,388	147,043	152,016	155,790	159,919	164,172	168,296	172,453

County	Population as of July 1, 2010	Population as of July 1, 2015	Population as of July 1, 2020	Population as of July 1, 2025	Population as of July 1, 2030	Population as of July 1, 2035	Population as of July 1, 2040	Population as of July 1, 2045	Population as of July 1, 2050
Rutherford	67,621	65,339	64,472	64,697	65,552	66,396	67,230	68,048	68,856
Sampson	63,406	61,328	59,056	58,919	58,862	58,836	58,826	58,821	58,821
Scotland	36,028	35,063	34,156	32,738	32,093	31,456	30,818	30,183	29,543
Stanly	60,533	60,316	62,607	63,346	64,296	65,302	66,309	67,316	68,322
Stokes	47,267	45,341	44,561	45,444	45,726	45,818	45,848	45,858	45,860
Surry	73,716	71,337	71,326	71,191	70,964	70,736	70,507	70,279	70,051
Swain	13,998	14,693	14,106	14,465	14,649	14,813	14,974	15,133	15,293
Transylvania	33,033	32,655	33,020	33,936	34,755	35,574	36,393	37,211	38,030
Tyrrell	4,404	4,021	3,240	3,097	2,942	2,799	2,661	2,532	2,409
Union	202,100	219,119	238,980	262,980	292,658	323,920	355,641	387,491	419,382
Vance	45,212	43,428	42,587	41,544	41,266	41,196	41,177	41,172	41,171
Wake	907,514	1,020,921	1,132,620	1,237,890	1,366,607	1,496,292	1,625,997	1,755,702	1,885,406
Warren	20,940	19,927	18,634	18,925	18,974	19,007	19,033	19,058	19,082
Washington	13,087	11,915	10,984	10,085	9,332	8,716	8,228	7,859	7,598
Watauga	50,900	52,331	54,483	54,004	57,018	58,532	60,737	62,434	64,614
Wayne	122,672	120,823	117,340	117,301	117,098	117,015	116,983	116,967	116,965
Wilkes	69,157	67,340	65,983	65,408	64,975	64,662	64,527	64,634	65,040
Wilson	81,190	79,167	79,374	76,495	75,760	76,201	77,288	78,730	80,365
Yadkin	38,410	37,259	37,218	37,040	37,002	36,993	36,993	36,990	36,991
Yancey	17,797	17,766	18,486	18,406	18,328	18,246	18,165	18,085	18,006
State of North Carolina	9,571,007	9,968,747	10,463,226	11,038,826	11,625,716	12,221,349	12,817,720	13,414,872	14,012,819

Attachment 6

2020 SMFP

Table 17C-5: Linear Accelerator Service Areas and Calculations

Service Area	2019 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service	2017-2018 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	146,739	2	73,370	6.89%	4,358	2,179	-1.35	
Area 2	432,064	8	54,008	19.30%	35,093	4,387	-2.80	
Area 3	104,501	1	104,501	18.64%	2,286	2,286	-0.66	
Area 4	175,975	3	58,658	16.20%	8,865	2,955	-1.69	
Area 5	373,126	6	62,188	11.25%	25,243	4,207	-2.26	
Area 6	477,918	5	95,584	7.90%	28,305	5,661	-0.81	
Area 7*	1,378,507	11	125,319	26.44%	65,901	5,991	-1.24	
Area 8	325,733	4	81,433	22.39%	19,476	4,869	-1.11	
Area 9	277,123	4	69,281	25.43%	17,671	4,418	-1.38	
Area 10	665,269	10	66,527	27.93%	57,029	5,703	-1.55	
Area 11*	168,798	1	168,798	19.85%	2,748	2,748	-0.59	
Area 12	629,948	7	89,993	15.55%	36,761	5,252	-1.55	
Area 13*	144,125	1	144,125	15.50%	4,590	4,590	-0.32	
Area 14**	222,174	6	37,029	78.40%	38,228	6,371	-0.34	
Area 15	191,810	2	95,905	14.60%	15,711	7,855	0.33	
Area 16**	484,003	10	48,400	63.51%	47,257	4,726	-3.00	
Area 17	327,088	3	109,029	30.53%	19,476	6,492	-0.11	
Area 18	557,768	9	61,974	17.57%	27,896	3,100	-4.87	
Area 19*	497,630	4	124,408	10.50%	27,747	6,937	0.11	
Area 20	1,165,211	11	105,928	15.48%	47,845	4,350	-3.91	
Area 21*	136,031	1	136,031					
Area 22**	204,784	2	102,392	49.14%	9,682	4,841	-0.57	
Area 23*	242,011	2	121,006	11.28%	10,342	5,171	-0.47	
Area 24	198,058	3	66,019	12.40%	16,042	5,347	-0.62	
Area 25*	201,213	1	201,213	3.95%	4,672	4,672	-0.31	
Area 26	302,821	4	75,705	7.29%	11,872	2,968	-2.24	
Area 27	333,987	7	47,712	32.10%	24,951	3,564	-3.30	
Area 28	160,133	2	80,067	4.72%	7,268	3,634	-0.92	
Totals	**10,524,548**	**130**	**80,958**		**617,310**	**4,749**	**-38.55**	

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

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Table 17C-5: Linear Accelerator Service Areas and Calculations

Service Area	2020 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2018-2019 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	146,569	2	73,285	10.03%	4,601	2,301	-1.32	
Area 2	434,659	8	54,332	19.79%	35,010	4,376	-2.81	
Area 3	104,916	1	104,916	13.40%	2,075	2,075	-0.69	
Area 4	177,388	3	59,129	10.28%	9,959	3,320	-1.52	
Area 5	374,896	6	62,483	7.59%	24,822	4,137	-2.32	
Area 6	481,387	5	96,277	8.18%	27,672	5,534	-0.90	
Area 7*	1,399,288	11	127,208	20.65%	75,340	6,849	0.16	
Area 8	327,282	4	81,821	24.00%	19,891	4,973	-1.05	
Area 9	280,844	4	70,211	26.05%	16,909	4,227	-1.49	
Area 10	666,915	10	66,692	27.07%	50,793	5,079	-2.48	
Area 11*	170,888	1	170,888	14.04%	4,093	4,093	-0.39	
Area 12	637,178	7	91,025	23.57%	45,206	6,458	-0.30	
Area 13*	145,807	1	145,807	10.67%	3,848	3,848	-0.43	
Area 14**	226,323	6	37,721	79.02%	40,917	6,819	0.06	
Area 15	197,721	2	98,861	14.41%	10,053	5,027	-0.51	
Area 16**	489,038	10	48,904	63.44%	46,619	4,662	-3.09	
Area 17	329,576	3	109,859	23.44%	20,523	6,841	0.04	
Area 18	562,640	8	70,330	14.11%	29,135	3,642	-3.68	
Area 19*	506,205	4	126,551	11.20%	30,752	7,688	0.56	1
Area 20	1,180,095	11	107,281	16.14%	47,543	4,322	-3.96	
Area 21*	137,358	1	137,358		0	0	-1.00	
Area 22	212,401	2	106,201	42.63%	10,462	5,231	-0.45	
Area 23*	242,325	2	121,163	9.19%	11,311	5,655	-0.32	
Area 24	199,100	3	66,367	15.22%	16,240	5,413	-0.59	
Area 25*	204,357	1	204,357	9.58%	4,395	4,395	-0.35	
Area 26	302,141	4	75,535	6.14%	12,761	3,190	-2.11	
Area 27	333,344	6	55,557	33.08%	20,211	3,368	-3.01	
Area 28	160,050	2	80,025	3.33%	8,605	4,303	-0.73	
Totals	**10,630,691**	**128**	**83,052**		**629,741**	**4,920**	**-34.71**	**1**

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

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Table 17C-5: Linear Accelerator Service Areas and Calculations

Service Area	2021 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2019-2020 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	146,591	2	73,296	6.78%	4,325	2,163	-1.36	
Area 2	432,198	8	54,025	22.77%	36,320	4,540	-2.62	
Area 3	103,076	1	103,076	15.25%	3,339	3,339	-0.51	
Area 4	176,963	3	58,988	17.00%	10,263	3,421	-1.48	
Area 5	375,970	6	62,662	6.84%	24,622	4,104	-2.35	
Area 6	485,085	5	97,017	8.19%	30,869	6,174	-0.43	
Area 7*	1,403,469	11	127,588	21.31%	76,249	6,932	0.30	1
Area 8	327,913	4	81,978	23.76%	19,320	4,830	-1.14	
Area 9	284,671	4	71,168	26.06%	16,457	4,114	-1.56	
Area 10	666,413	10	66,641	27.81%	54,288	5,429	-1.96	
Area 11*	171,014	1	171,014	10.71%	3,820	3,820	-0.43	
Area 12	631,125	7	90,161	22.16%	44,324	6,332	-0.43	
Area 13*	145,480	1	145,480	5.44%	3,270	3,270	-0.52	
Area 14**	227,027	6	37,838	71.62%	40,380	6,730	-0.02	
Area 15	195,020	2	97,510	15.71%	9,556	4,778	-0.58	
Area 16**	491,941	10	49,194	63.65%	45,027	4,503	-3.33	
Area 17	328,960	3	109,653	25.11%	19,483	6,494	-0.11	
Area 18	562,195	8	70,274	17.64%	29,694	3,712	-3.60	
Area 19	508,461	5	101,692	12.51%	32,530	6,506	-0.18	
Area 20	1,189,588	11	108,144	14.79%	46,285	4,208	-4.14	
Area 21*	138,043	1	138,043	0	0	0	-1	
Area 22	216,670	2	108,335	40.24%	10,269	5,135	-0.48	
Area 23*	243,144	2	121,572	11.13%	11,213	5,606	-0.34	
Area 24	197,469	3	65,823	15.13%	16,520	5,507	-0.55	
Area 25*	211,881	1	211,881	9.83%	5,195	5,195	-0.23	
Area 26	302,378	4	75,595	5.18%	13,188	3,297	-2.05	
Area 27	335,494	6	55,916	33.03%	28,962	4,827	-1.71	
Area 28	160,478	2	80,239	4.32%	7,525	3,763	-0.89	
Totals	**10,658,717**	**129**	**82,626**		**643,289**	**4,987**	**-34.70**	**1**

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

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Table 17C-5: Linear Accelerator Service Areas and Calculations

Service Area	2022 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2020-2021 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	143,240	2	71,620	4.05%	2,699	1,349	-1.60	
Area 2	437,408	8	54,676	25.25%	32,547	4,068	-3.18	
Area 3	98,457	1	98,457	18.49%	2,260	2,260	-0.67	
Area 4	170,143	3	56,714	14.42%	10,193	3,398	-1.49	
Area 5	365,327	6	60,888	9.13%	22,652	3,775	-2.64	
Area 6	486,434	5	97,287	9.85%	33,327	6,665	-0.06	
Area 7	1,423,655	12	118,638	22.19%	79,164	6,597	-0.27	
Area 8	343,520	4	85,880	22.71%	19,652	4,913	-1.09	
Area 9	298,918	4	74,730	26.06%	15,564	3,891	-1.69	
Area 10	660,182	10	66,018	28.05%	53,254	5,325	-2.11	
Area 11*	171,063	1	171,063	9.33%	3,743	3,743	-0.45	
Area 12	643,724	7	91,961	21.48%	41,438	5,920	-0.86	
Area 13*	145,359	1	145,359	12.77%	3,338	3,338	-0.51	
Area 14**	230,595	6	38,433	80.60%	40,297	6,716	-0.03	
Area 15	197,355	2	98,678	15.68%	9,613	4,806	-0.58	
Area 16**	495,501	10	49,550	61.53%	46,277	4,628	-3.14	
Area 17	322,475	3	107,492	23.96%	12,045	4,015	-1.22	
Area 18	532,337	8	66,542	16.59%	25,588	3,198	-4.21	
Area 19	484,598	5	96,920	17.38%	31,848	6,370	-0.28	
Area 20	1,251,139	11	113,740	17.45%	47,861	4,351	-3.91	
Area 21*	136,079	1	136,079		0	0	-1.00	
Area 22**	230,077	2	115,039	46.87%	9,608	4,804	-0.58	
Area 23	215,878	2	107,939	14.36%	14,000	7,000	0.07	
Area 24	187,930	4	46,983	17.73%	16,861	4,215	-1.50	
Area 25*	208,825	1	208,825	14.88%	4,559	4,559	-0.32	
Area 26	284,789	4	71,197	6.18%	13,382	3,345	-2.02	
Area 27	307,784	6	51,297	29.68%	31,966	5,328	-1.26	
Area 28	158,875	2	79,438	4.43%	8,026	4,013	-0.81	
Totals	**10,631,667**	**131**	**81,158**		**631,756**	**4,823**	**-37.41**	

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

Table 15C-5: Linear Accelerator Service Areas and Calculations

Service Area	2023 Population	Accelerators	Population within Service Area Per Accelerator	Percentage of Patients from Outside the Service Area	2021-2022 ESTV Procedures	Procedures Per Accelerator	ESTV Procedures Divided by 6,750 Minus # of Accelerators	Need Determinations
Area 1	144,685	2	72,343	15.69%	3,339	1,670	-1.51	
Area 2	440,212	8	55,027	27.38%	33,093	4,137	-3.10	
Area 3	98,197	1	98,197	14.06%	2,336	2,336	-0.65	
Area 4	171,237	3	57,079	11.25%	11,251	3,750	-1.33	
Area 5	369,403	6	61,567	17.67%	21,492	3,582	-2.82	
Area 6	501,349	5	100,270	10.10%	31,413	6,283	-0.35	
Area 7	1,433,456	12	119,455	22.00%	76,757	6,396	-0.63	
Area 8	350,759	4	87,690	28.57%	20,341	5,085	-0.99	
Area 9	303,520	4	75,880	25.30%	16,615	4,154	-1.54	
Area 10	662,900	10	66,290	36.73%	33,830	3,383	-4.99	
Area 11*	173,876	1	173,876	20.57%	3,181	3,181	-0.53	
Area 12	638,925	7	91,275	20.23%	42,949	6,136	-0.64	
Area 13*	146,470	1	146,470	13.70%	3,884	3,884	-0.42	
Area 14**	230,834	6	38,472	74.69%	39,067	6,511	-0.21	
Area 15	201,188	2	100,594	17.91%	9,630	4,815	-0.57	
Area 16**	500,359	10	50,036	62.40%	50,202	5,020	-2.56	
Area 17	330,164	3	110,055	21.88%	11,583	3,861	-1.28	
Area 18	550,660	8	68,833	13.45%	29,397	3,675	-3.64	
Area 19*	513,357	4	128,339	11.58%	34,506	8,626	1.11	1
Area 20	1,265,403	12	105,450	10.01%	49,329	4,111	-4.69	
Area 21*	143,081	1	143,081		0	0	-1.00	
Area 22*	242,959	2	121,480	43.45%	11,557	5,779	-0.29	
Area 23	220,500	2	110,250	13.79%	13,670	6,835	0.03	
Area 24	192,898	4	48,225	17.17%	16,726	4,182	-1.52	
Area 25*	212,036	1	212,036	17.75%	2,694	2,694	-0.60	
Area 26	284,076	4	71,019	4.97%	11,567	2,892	-2.29	
Area 27	308,600	6	51,433	28.90%	27,359	4,560	-1.95	
Area 28	163,359	2	81,680	4.41%	8,613	4,307	-0.72	
Totals	**10,794,463**	**131**	**82,400**		**616,376**	**4,705**	**-39.69**	

* Service Area has at least 120,000 base population per accelerator.

** Area has more than 45% of its patients coming from outside the service areas.

Attachment 7

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Table 17C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2017-9/30/2018	Average Number of Procedures per Unit
UNC Rockingham Health Care	12	Rockingham	1	6,510	6,510
Randolph Hospital	13	Randolph	1	4,590	4,590
University of North Carolina Hospitals	14	Orange	6	38,228	6,371
Alamance Regional Medical Center	15	Alamance	2	15,711	7,855
Duke Regional Hospital	16	Durham	1	4,996	4,996
Duke University Hospital	16	Durham	8	38,266	4,783
Maria Parham Medical Center	16	Vance	1	3,996	3,996
FirstHealth Moore Regional Hospital	17	Moore	2	16,461	8,231
Scotland Memorial Hospital	17	Scotland	1	3,015	3,015
Cape Fear Valley Medical Center	18	Cumberland	5	17,481	3,496
Southeastern Regional Medical Center***	18	Robeson	2	7,823	3,911
NC Radiation Therapy - Sampson	18	Sampson	1	2,592	2,592
New Hanover Regional Medical Center**	19	New Hanover	4	27,747	6,937
Franklin County Cancer Center	20	Franklin	1	33	33
Duke Raleigh Hospital	20	Wake	4	19,929	4,982
Rex Hospital	20	Wake	4	22,514	5,628
UNC Hospitals Radiation Oncology - Holly Springs	20	Wake	1		
UNC REX Cancer Care of East Raleigh	20	Wake	1	5,370	5,370
Central Harnett Hospital	21	Harnett	1		
Johnston Radiation Oncology	22	Johnston	1	5,182	5,182
Smithfield Radiation Oncology	22	Johnston	1	4,500	4,500
UNC Lenoir HealthCare	23	Lenoir	1	5,400	5,400
NC Radiation Therapy - Goldsboro	23	Wayne	1	4,942	4,942
Carteret General Hospital	24	Carteret	1	6,241	6,241
CarolinaEast Medical Center	24	Craven	2	9,801	4,901
Onslow Radiation Oncology	25	Onslow	1	4,672	4,672
NC Radiation Therapy - Roanoke Rapids	26	Halifax	1	2,162	2,162
Nash General Hospital	26	Nash	2	7,890	3,945
Wilson Medical Center	26	Wilson	1	1,820	1,820
Vidant Beaufort Hospital	27	Beaufort	1	3,244	3,244
Vidant Roanoke-Chowan Hospital	27	Hertford	1	3,016	3,016
North Carolina Radiation Therapy Management Services	27	Pitt	5	18,691	3,738
The Outer Banks Hospital, Inc.	28	Dare	1	2,325	2,325
Sentara Albemarle Medical Center	28	Pasquotank	1	4,943	4,943

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Table 17C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2018-9/30/2019	Average Number of Procedures per Unit
High Point Regional Health	12	Guilford	2	10,856	5,428
UNC Rockingham Health Care	12	Rockingham	1	5,255	5,255
Randolph Hospital	13	Randolph	1	3,848	3,848
University of North Carolina Hospitals	14	Orange	6	40,917	6,819
Alamance Regional Medical Center	15	Alamance	2	10,053	5,027
Duke Regional Hospital	16	Durham	1	2,099	2,099
Duke University Hospital	16	Durham	8	40,578	5,072
Maria Parham Medical Center	16	Vance	1	3,943	3,943
FirstHealth Moore Regional Hospital	17	Moore	2	16,437	8,218
Scotland Memorial Hospital	17	Scotland	1	4,087	4,087
Cape Fear Valley Medical Center	18	Cumberland	5	18,611	3,722
Southeastern Regional Medical Center***	18	Robeson	2	7,591	3,796
North Carolina Radiation Therapy Management Services - Clinton	18	Sampson	1	2,933	2,933
New Hanover Regional Medical Center**	19	New Hanover	4	30,752	7,688
Franklin County Cancer Center	20	Franklin	1	0	0
Duke Raleigh Hospital	20	Wake	4	21,286	5,322
Rex Hospital	20	Wake	4	22,493	5,623
UNC Hospital Radiation Oncology -Holly Springs	20	Wake	1	0	0
UNC Rex Cancer Care of East Raleigh	20	Wake	1	3,764	3,764
Central Harnett Hospital	21	Harnett	1	0	0
Johnston Radiation Oncology	22	Johnston	1	5,932	5,932
Smithfield Radiation Oncology	22	Johnston	1	4,530	4,530
UNC Lenoir HealthCare	23	Lenoir	1	6,398	6,398
North Carolina Radiation Therapy Management Services - Goldsboro	23	Wayne	1	4,913	4,913
Carteret General Hospital	24	Carteret	1	6,427	6,427
CarolinaEast Medical Center	24	Craven	2	9,813	4,906
Onslow Radiation Oncology, LLC	25	Onslow	1	4,395	4,395
North Carolina Radiation Therapy Management Services - Roanoke Rapids	26	Halifax	1	2,163	2,163
Nash General Hospital	26	Nash	2	8,494	4,247
Wilson Medical Center	26	Wilson	1	2,104	2,104
Vidant Beaufort Hospital	27	Beaufort	1	8,280	8,280
Vidant Roanoke-Chowan Hospital	27	Hertford	1	2,254	2,254
North Carolina Radiation Therapy Management Services - Greeneville	27	Pitt	4	9,677	2,419
The Outer Banks Hospital, Inc.	28	Dare	1	2,851	2,851
Sentara Albemarle Medical Center	28	Pasquotank	1	5,754	5,754

Table 17C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2019-9/30/2020	Average Number of Procedures per Unit
High Point Regional Health	12	Guilford	2	10,360	5,180
UNC Rockingham Health Care	12	Rockingham	1	6,254	6,254
Randolph Hospital	13	Randolph	1	3,270	3,270
University of North Carolina Hospitals	14	Orange	6	40,380	6,730
Alamance Regional Medical Center	15	Alamance	2	9,556	4,778
Duke Regional Hospital	16	Durham	1	4,266	4,266
Duke University Hospital	16	Durham	8	36,819	4,602
Maria Parham Medical Center	16	Vance	1	3,943	3,943
FirstHealth Moore Regional Hospital	17	Moore	2	15,885	7,942
Scotland Memorial Hospital	17	Scotland	1	3,599	3,599
Cape Fear Valley Medical Center	18	Cumberland	5	17,916	3,583
Southeastern Regional Medical Center***	18	Robeson	2	8,475	4,237
North Carolina Radiation Therapy Management Services - Clinton	18	Sampson	1	3,303	3,303
2021 Need Determination	19	New Hanover	1	0	0
New Hanover Regional Medical Center**	19	New Hanover	4	32,530	8,132
Franklin County Cancer Center	20	Franklin	1	0	0
Duke Raleigh Hospital	20	Wake	4	19,985	4,996
Rex Hospital	20	Wake	4	22,858	5,714
UNC Hospital Radiation Oncology -Holly Springs	20	Wake	1	0	0
UNC Rex Cancer Care of East Raleigh	20	Wake	1	3,443	3,443
Central Harnett Hospital	21	Harnett	1	0	0
Johnston Radiation Oncology	22	Johnston	1	6,708	6,708
Smithfield Radiation Oncology	22	Johnston	1	3,561	3,561
UNC Lenoir HealthCare	23	Lenoir	1	6,353	6,353
North Carolina Radiation Therapy Management Services - Goldsboro	23	Wayne	1	4,860	4,860
Carteret General Hospital	24	Carteret	1	6,870	6,870
CarolinaEast Medical Center	24	Craven	2	9,650	4,825
Onslow Radiation Oncology, LLC	25	Onslow	1	5,195	5,195
North Carolina Radiation Therapy Management Services - Roanoke Rapids	26	Halifax	1	2,373	2,373
Nash General Hospital	26	Nash	2	9,094	4,547
Wilson Medical Center	26	Wilson	1	1,721	1,721
Vidant Beaufort Hospital	27	Beaufort	1	4,089	4,089
Vidant Roanoke-Chowan Hospital	27	Hertford	1	2,297	2,297
North Carolina Radiation Therapy Management Services - Greenville	27	Pitt	4	22,576	5,644
The Outer Banks Hospital, Inc.	28	Dare	1	2,561	2,561
Sentara Albemarle Medical Center	28	Pasquotank	1	4,964	4,964

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Table 17C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2020-9/30/2021	Average Number of Procedures per Unit
Hugh Chatham Memorial Hospital	10	Surry	1	4,323	4,323
Lexington Medical Center	11	Davidson	1	3,743	3,743
Cone Health-Moses H. Cone Memorial Hospital	12	Guilford	4	28,509	7,127
High Point Regional Health	12	Guilford	2	9,825	4,912
UNC Rockingham Health Care	12	Rockingham	1	3,104	3,104
Randolph Hospital	13	Randolph	1	3,338	3,338
University of North Carolina Hospitals	14	Orange	6	40,297	6,716
Alamance Regional Medical Center	15	Alamance	2	9,613	4,806
Duke Regional Hospital	16	Durham	1	4,011	4,011
Duke University Hospital	16	Durham	8	38,293	4,787
Maria Parham Medical Center	16	Vance	1	3,974	3,974
FirstHealth Moore Regional Hospital	17	Moore	2	8,265	4,133
Scotland Memorial Hospital	17	Scotland	1	3,780	3,780
Cape Fear Valley Medical Center	18	Cumberland	5	15,977	3,195
Southeastern Regional Medical Center***	18	Robeson	2	7,090	3,545
North Carolina Radiation Therapy Management Services - Clinton	18	Sampson	1	2,521	2,521
New Hanover Regional Medical Center	19	New Hanover	5	31,848	6,370
Franklin County Cancer Center	20	Franklin	1	0	0
Duke Raleigh Hospital	20	Wake	4	21,075	5,269
UNC Hospital Radiation Oncology -Holly Springs	20	Wake	1	0	0
UNC Rex Cancer Center of East Raleigh	20	Wake	1	5,148	5,148
UNC Rex Hospital	20	Wake	4	21,639	5,410
Central Harnett Hospital	21	Harnett	1	0	0
Clayton Radiation Oncology	22	Johnston	1	7,498	7,498
Smithfield Radiation Oncology	22	Johnston	1	2,110	2,110
UNC Lenoir HealthCare	23	Lenoir	1	8,855	8,855
North Carolina Radiation Therapy Management Services - Goldsboro	23	Wayne	1	5,145	5,145
Carteret General Hospital	24	Carteret	2	7,322	3,661
CarolinaEast Medical Center	24	Craven	2	9,539	4,770
Onslow Radiation Oncology, LLC	25	Onslow	1	4,559	4,559
North Carolina Radiation Therapy Management Services - Roanoke Rapids	26	Halifax	1	2,405	2,405
Nash General Hospital	26	Nash	2	9,534	4,767
Wilson Medical Center	26	Wilson	1	1,443	1,443
Vidant Beaufort Hospital	27	Beaufort	1	3,696	3,696
Vidant Radiation Oncology	27	Hertford	1	1,937	1,937
Vidant Radiation Oncology	27	Pitt	3	20,071	6,690
Vidant Radiation Oncology	27	Pitt	1	6,262	6,262

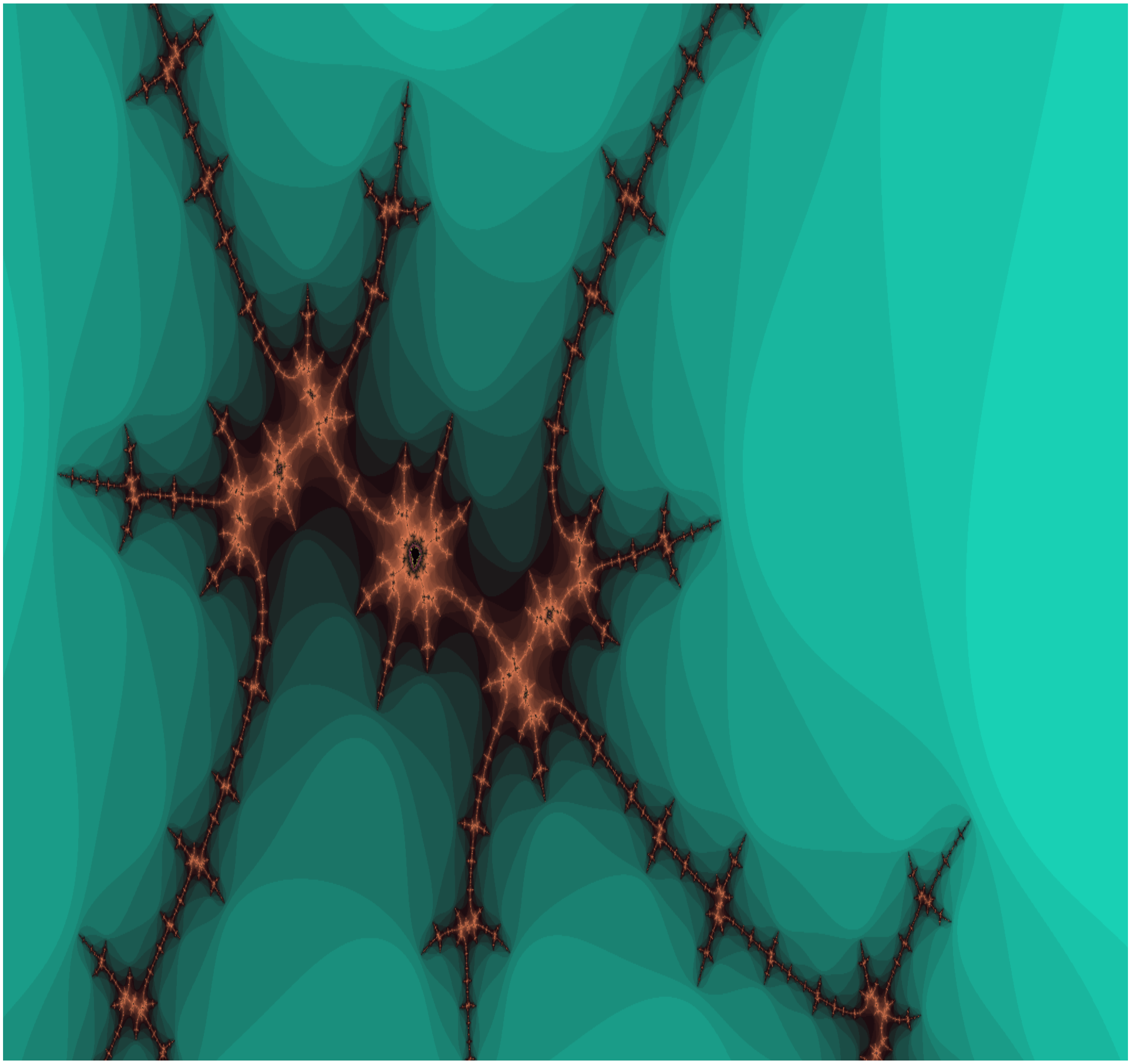
Table 15C-1: Hospital and Free-Standing Linear Accelerators and Radiation Oncology Procedures

Facility Name	Service Area Number	County	Number of Linear Accelerators	Number of Procedures (ESTVs) 10/1/2021-9/30/2022	Average Number of Procedures per Unit
Lexington Medical Center	11	Davidson	1	3,181	3,181
Cone Health	12	Guilford	4	30,468	7,617
High Point Medical Center	12	Guilford	2	9,977	4,988
UNC Rockingham Hospital	12	Rockingham	1	2,505	2,505
Randolph Health	13	Randolph	1	3,884	3,884
University of North Carolina Hospitals at Chapel Hill, DBA UNC Hospitals	14	Orange	6	39,067	6,511
Alamance Regional Medical Center	15	Alamance	2	9,630	4,815
Duke Regional Hospital	16	Durham	1	3,497	3,497
Duke University Hospital Main Campus	16	Durham	8	40,503	5,063
Maria Parham Health	16	Vance	1	6,203	6,203
FH Moore Regional Hospital	17	Moore	2	8,592	4,296
Scotland Memorial Hospital	17	Scotland	1	2,991	2,991
Cape Fear Valley Medical Center	18	Cumberland	5	19,399	3,880
Southeastern Regional Medical Center	18	Robeson	2	6,525	3,262
North Carolina Radiation Therapy Management Services - Clinton	18	Sampson	1	3,473	3,473
New Hanover Regional Medical Center**	19	New Hanover	4	34,506	8,626
Franklin County Cancer Center	20	Franklin	1	0	0
2023 Need Determination	20	Wake	1	0	0
Duke Raleigh Hospital	20	Wake	4	23,733	5,933
Rex Hospital	20	Wake	4	21,356	5,339
UNC Hospital Radiation Oncology -Holly Springs	20	Wake	1	0	0
UNC Rex Cancer Center of East Raleigh	20	Wake	1	4,247	4,247
Central Harnett Hospital	21	Harnett	1	0	0
Johnston Health Clayton Professional Plaza	22	Johnston	1	6,319	6,319
Smithfield Radiation Oncology	22	Johnston	1	5,239	5,239
Main Campus	23	Lenoir	1	7,653	7,653
North Carolina Radiation Therapy Management Services - Goldsboro	23	Wayne	1	6,017	6,017
Carteret Health Care	24	Carteret	2	6,980	3,490
CarolinaEast Medical Center	24	Craven	2	9,746	4,873
Onslow Radiation Oncology, LLC	25	Onslow	1	2,694	2,694
North Carolina Radiation Therapy Management Services - Roanoke Rapids	26	Halifax	1	2,484	2,484
Nash Hospitals Inc.	26	Nash	2	7,706	3,853
Wilson Radiation Oncology	26	Wilson	1	1,377	1,377
ECU Health Beaufort Hospital	27	Beaufort	1	4,354	4,354
Vidant Radiation Oncology	27	Hertford	1	2,026	2,026
Vidant Radiation Oncology	27	Pitt	3	14,375	4,792
Vidant Radiation Oncology	27	Pitt	1	6,604	6,604

Attachment 8

essentialresearch

Radiation Therapy Staffing and Workplace Survey 2020



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Executive Summary

Note: This survey data was collected before the COVID-19 pandemic began substantially affecting the surveyed clinical settings.

The 2020 Radiation Therapy Staffing and Workplace Survey was emailed to 14,027 radiation therapists in February 2020. At the close of the survey in March 2020, a total of 657 completed questionnaires had been submitted for a response rate of 4.7%

The sample size of 657 yields a margin of error for overall percentages of ± 3.8% at the 95% confidence interval.

To keep this report brief, responses to open-ended questions were not included, but are available upon request.

Staffing of Facilities

The mean number of budgeted full-time equivalents (FTEs) across all facilities surveyed is:

- 7.1 for radiation therapy.
- 2.5 for medical dosimetry.

An estimation of the overall percentages of unfilled positions was calculated using the number of budgeted FTEs along with figures on vacant and recruiting positions.

In radiation therapy, an estimated 7.2% of FTE positions are unfilled.

In medical dosimetry, an estimated 9.6% of FTE positions are unfilled.

Overall mean percentages of unfilled positions, calculated by combining the figures from both therapy and dosimetry, were highest in the Pacific region (14.0%) and lowest in the Mountain region (4.8%). Overall, the percent of unfilled positions combining both disciplines was 8.4%.

The survey also tracks longitudinal changes in staffing levels in radiation therapy and medical dosimetry. The number of FTE radiation therapists budgeted at each facility fell by 0.6 from 7.7 to 7.1 between 2018, when the last Radiation Therapy Staffing Survey was conducted, and 2020. Overall, the number of FTE therapists budgeted per facility has increased by 1.1 from 6.0 in 2004 to 7.1 in 2020.

- The number of FTE medical dosimetrists budgeted at each facility remained constant at 2.5.
- The estimated vacancy rate for FTE positions in therapy rose by 4.0%, from 3.2% in 2018 to 7.2% in 2020. This marks the third time in a row estimated vacancy rates have risen and is the largest single increase since the inception of the survey in 2004.
- The estimated vacancy rate for FTE positions in medical dosimetry rose by 7.2%, from 2.4% in 2018 to 9.6% in 2020. This reverses a downward trend in vacancy rates for medical dosimetry positions that began in 2012 and, as with the vacancy rates for therapy, represents the single largest rise in vacancy rates since the survey's inception.

Facility Demographics

A majority of respondents (56.4%) are staff therapists; 19.6% are senior/lead therapists, and 8.4% are medical dosimetrists.

There were respondents from every state except for Delaware and West Virginia.

Suburban facilities represented the largest share (42.7%) of respondents; 42.4% were urban, and the remaining 15.0% were rural.

The average respondent to the survey works in a facility that offers 13.8 services in radiation therapy and related fields. The most commonly offered services are:

- CT/simulation (94.9% of facilities).
- Intensity-modulated radiation therapy (IMRT) (94.9% of facilities).
- Cone-beam CT (CBCT) (92.6% of facilities).

The most commonly offered services remained the same from the previous survey in 2018.

The least commonly offered services are:

- Hyperthermia (4.7% of facilities).
- Proton therapy (5.9% of facilities).

- Dynamic adaptive radiation therapy (8.4% of facilities).

As with the most commonly offered services, the least commonly offered services remained the same from the previous iteration of the survey.

When asked which, if any, services they plan to expand, 58.3% said they plan to add additional LINAC therapy units, 19.7% plan to add real-time surface tracking, and 15.9% plan to add adaptive planning; 29.6% have no plans to add any of the new services listed.

According to the responses provided, the average facility treats 49.0 patients each day and uses 2.2 linear accelerators.

Personnel Demographics

The average respondent works at a facility that schedules 2.4 therapists and 1.1 dosimetrist per linear accelerator. On average, there are 0.7 hours per day when only one therapist is scheduled per linear accelerator.

Calculation of Percent Vacancy Rates

The estimated proportion of unfilled positions for a given specialty in the population of U.S. hospital-based radiology facilities is calculated as:

(mean number of vacant and recruiting FTEs per facility) / (mean number of budgeted FTEs per facility) * 100

For example, in radiation therapy the mean vacant and recruiting FTE positions per facility is 0.25. When divided by the mean budgeted FTE of 7.7, this yields a proportion of unfilled FTE positions of 0.032. Multiplying by 100 to give the percent value, and then rounding to the nearest tenth, gives the percent vacancy rate for radiation therapy of 3.2%.

Note that only responses that included both the number of budgeted FTEs and the number of vacant and recruiting FTEs were used in the calculation of vacancy rates.

Outliers

Numeric variables were analyzed for non-representative outliers with cross-tabulated scatter plots and box plots. By conventional definition, data points that were 1.5 times greater than the third quartile were designated as outliers and excluded from the analysis.

Staffing of Facilities

Provide the budgeted and vacant full-time equivalents (FTEs) for your facility. Please use decimals for fractional FTEs.

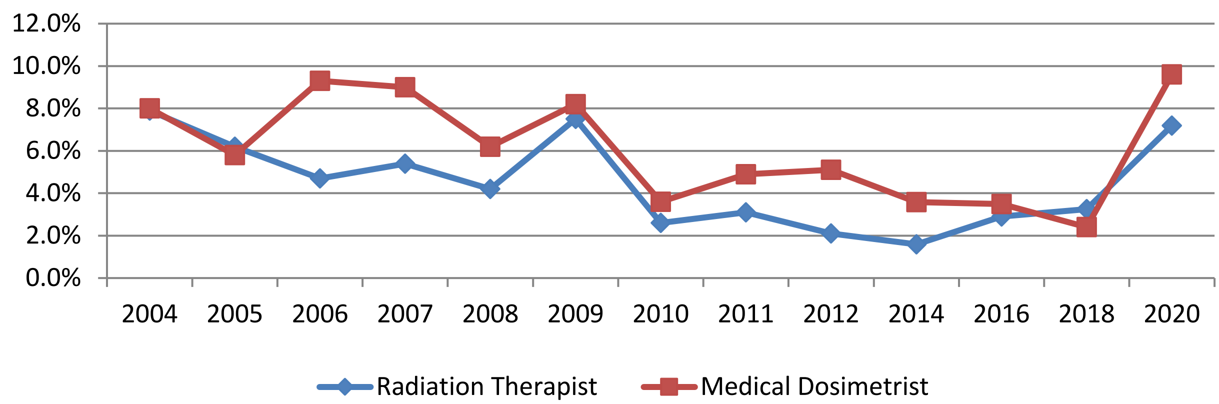
Radiation Therapist

Year	N	Mean Budgeted FTEs per facility	Mean Vacant and recruiting FTEs per facility	Estimated Percent unfilled FTE positions
2004	360	6.0	0.47	7.9%
2005	352	6.4	0.40	6.2%
2006	522	6.8	0.31	4.7%
2007	549	7.1	0.39	5.4%
2008	476	6.8	0.29	4.2%
2009	448	7.2	0.54	7.5%
2010	484	7.2	0.19	2.6%
2011	460	7.4	0.23	3.1%
2012	439	7.4	0.16	2.1%
2014	575	8.2	0.13	1.6%
2016	552	7.3	0.21	2.9%
2018	124	7.7	0.25	3.2%
2020	**517**	**7.1**	**0.51**	**7.2%**

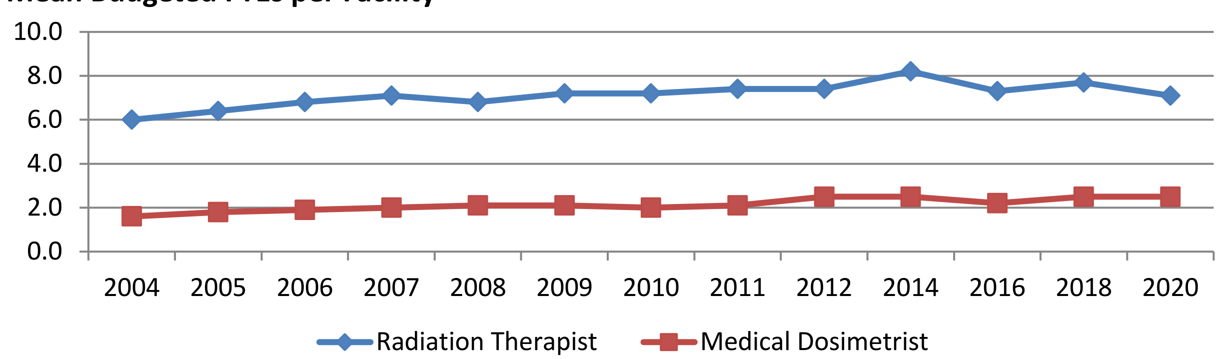
Medical Dosimetrist

Year	N	Mean Budgeted FTEs per facility	Mean Vacant and recruiting FTEs per facility	Estimated Percent unfilled FTE positions
2004	360	1.6	0.13	8.0%
2005	352	1.8	0.11	5.8%
2006	522	1.9	0.18	9.3%
2007	549	2.0	0.18	9.0%
2008	441	2.1	0.13	6.2%
2009	409	2.1	0.17	8.2%
2010	432	2.0	0.07	3.6%
2011	411	2.1	0.10	4.9%
2012	406	2.5	0.12	5.1%
2014	544	2.5	0.09	3.6%
2016	517	2.2	0.08	3.5%
2018	117	2.5	0.06	2.4%
2020	**447**	**2.5**	**0.24**	**9.6%**

Longitudinal Tracking of Estimated Percent Unfilled FTE Positions



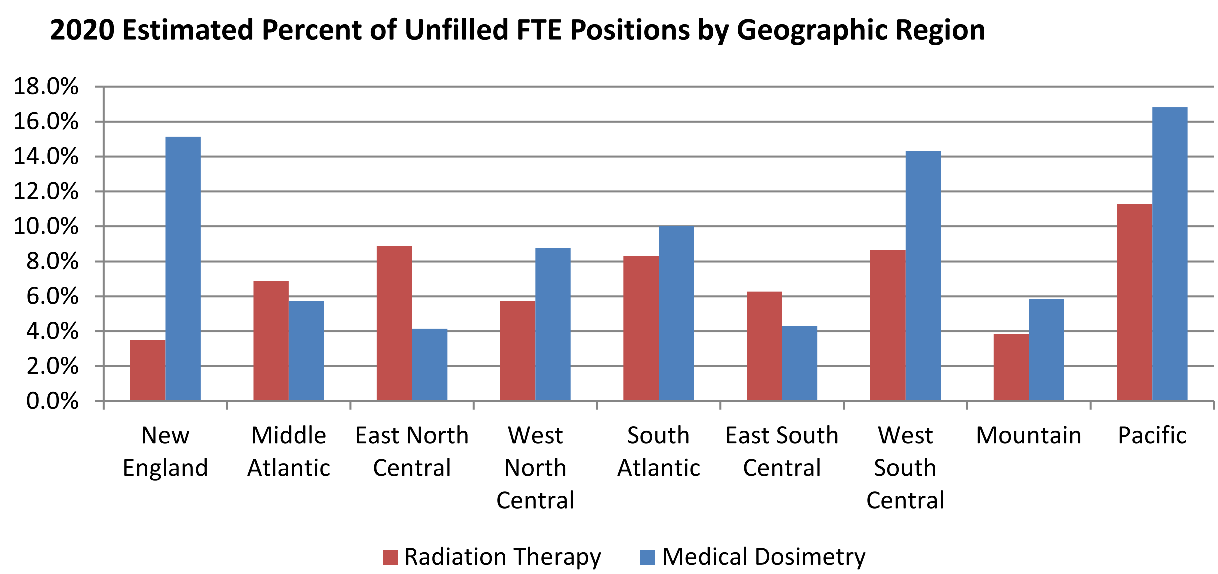
Mean Budgeted FTEs per Facility



2020 Estimated Percent of Unfilled FTE Positions by Geographic Region[a]

		New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Radiation Therapy	N	41	26	69	48	113	27	37	83	72
	%	3.5%	6.9%	8.9%	5.7%	8.3%	6.3%	8.7%	3.8%	11.3%
Medical Dosimetry	N	36	24	66	40	107	26	32	74	70
	%	15.1%	5.7%	4.1%	8.8%	10.0%	4.3%	14.3%	5.8%	16.8%
Overall Mean		8.9%	6.3%	6.6%	7.1%	9.1%	5.3%	11.3%	4.8%	14.0%

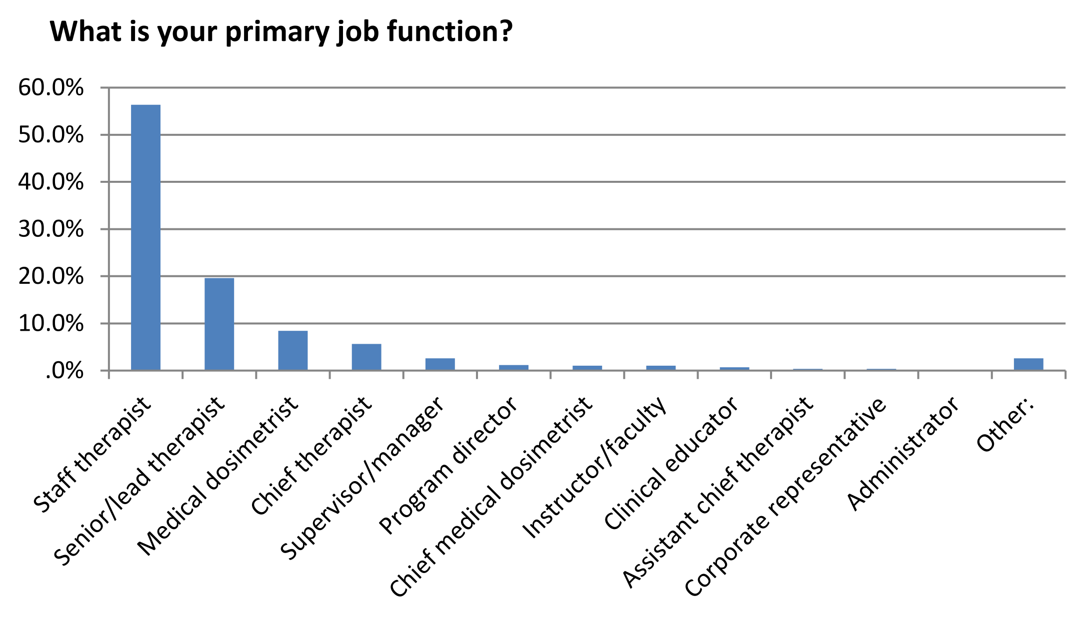
[a] Middle Atlantic: New York, Pennsylvania, and New Jersey
South Atlantic: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida
New England: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut
Mountain: Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico
Pacific: Alaska, Washington, Oregon, California, and Hawaii
West North Central: Missouri, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, and Iowa
East North Central: Wisconsin, Michigan, Illinois, Indiana, and Ohio
East South Central: Kentucky, Tennessee, Mississippi, and Alabama
West South Central: Oklahoma, Texas, Arkansas, and Louisiana



Facility Demographics

What is your primary job function?

	N	Valid Percent
Staff therapist	328	56.4%
Senior/lead therapist	114	19.6%
Medical dosimetrist	49	8.4%
Chief therapist	33	5.7%
Supervisor/manager	15	2.6%
Program director	7	1.2%
Chief medical dosimetrist	6	1.0%
Instructor/faculty	6	1.0%
Clinical educator	4	0.7%
Assistant chief therapist	2	0.3%
Corporate representative	2	0.3%
Administrator	1	0.2%
Other:	15	2.6%
Total	582	100.0%



Responding Facilities by State

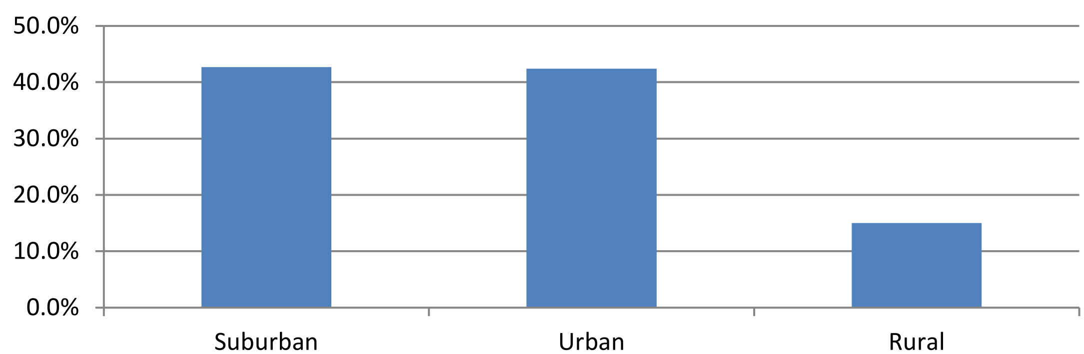
State	N	State	N	State	N	State	N	State	N
Alabama	8	**Hawaii**	2	**Massachusetts**	15	**New Mexico**	3	**South Dakota**	5
Alaska	1	**Idaho**	6	**Michigan**	31	**New York**	37	**Tennessee**	12
Arizona	11	**Illinois**	23	**Minnesota**	27	**North Carolina**	16	**Texas**	34
Arkansas	5	**Indiana**	32	**Mississippi**	4	**North Dakota**	2	**Utah**	3
California	60	**Iowa**	5	**Missouri**	12	**Ohio**	18	**Vermont**	4
Colorado	10	**Kansas**	9	**Montana**	4	**Oklahoma**	5	**Virginia**	20
Connecticut	11	**Kentucky**	10	**Nebraska**	11	**Oregon**	6	**Washington**	11
Delaware	0	**Louisiana**	6	**Nevada**	6	**Pennsylvania**	25	**West Virginia**	0
Florida	40	**Maine**	3	**New Hampshire**	7	**Rhode Island**	1	**Wisconsin**	31
Georgia	16	**Maryland/DC**	16	**New Jersey**	18	**South Carolina**	9	**Wyoming**	2

*N.b. There were 4 respondents from outside of the United States.

Location of Facility:

	N	Valid Percent
Suburban	279	42.7%
Urban	277	42.4%
Rural	98	15.0%
Total	654	100.0%

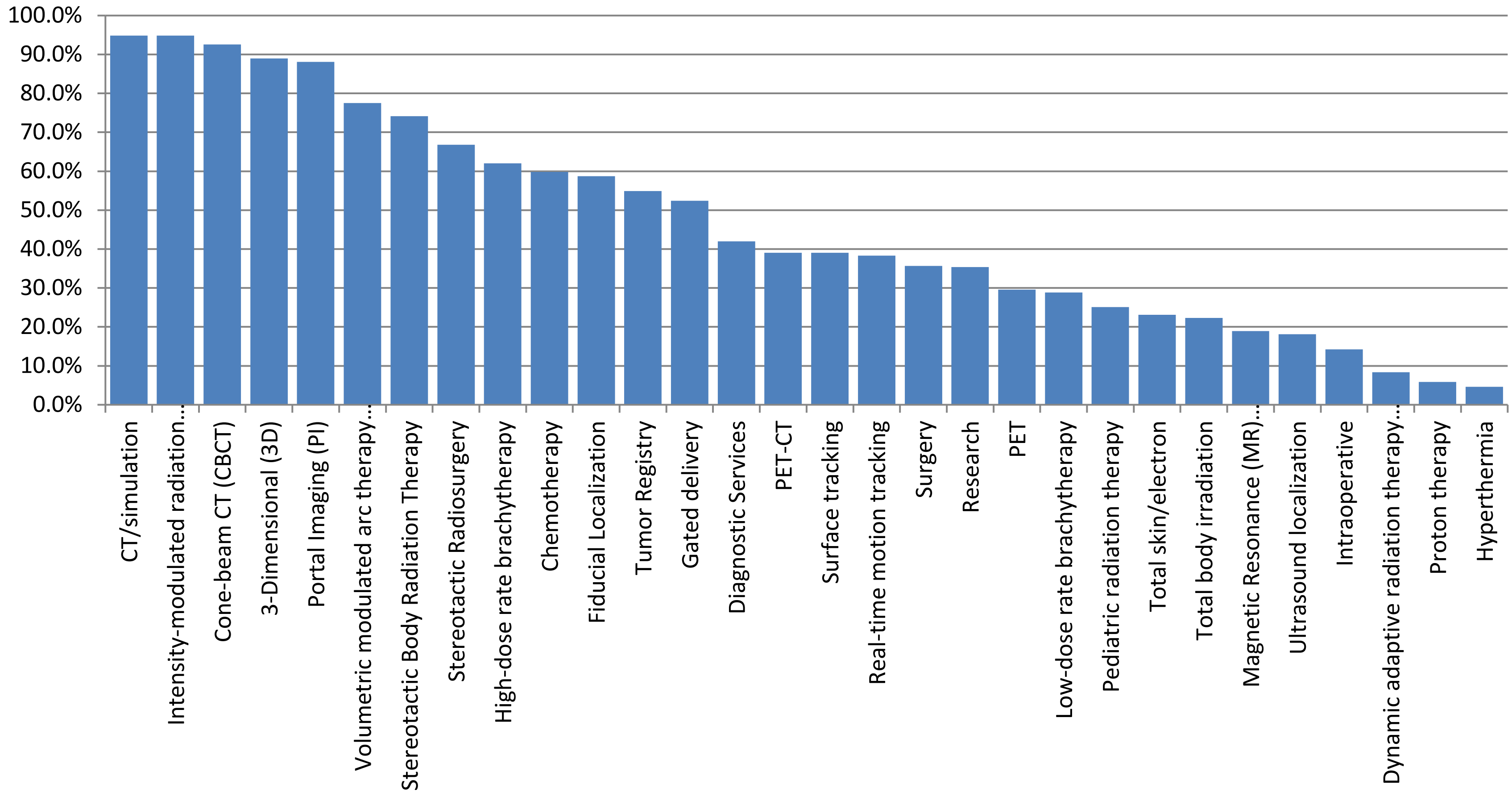
Location of facility:



Which of the following services does your facility provide?

	N	Percent of Cases
CT/simulation	612	94.9%
Intensity-modulated radiation therapy (IMRT)	612	94.9%
Cone-beam CT (CBCT)	597	92.6%
3-Dimensional (3D)	574	89.0%
Portal Imaging (PI)	568	88.1%
Volumetric modulated arc therapy (VMAT)	500	77.5%
Stereotactic Body Radiation Therapy	478	74.1%
Stereotactic Radiosurgery	431	66.8%
High-dose rate brachytherapy	400	62.0%
Chemotherapy	386	59.8%
Fiducial Localization	379	58.8%
Tumor Registry	354	54.9%
Gated delivery	338	52.4%
Diagnostic Services	271	42.0%
PET-CT	252	39.1%
Surface tracking	252	39.1%
Real-time motion tracking	247	38.3%
Surgery	230	35.7%
Research	228	35.3%
PET	191	29.6%
Low-dose rate brachytherapy	186	28.8%
Pediatric radiation therapy	162	25.1%
Total skin/electron	149	23.1%
Total body irradiation	144	22.3%
Magnetic Resonance (MR) localization	122	18.9%
Ultrasound localization	117	18.1%
Intraoperative	92	14.3%
Dynamic adaptive radiation therapy (DART)	54	8.4%
Proton therapy	38	5.9%
Hyperthermia	30	4.7%

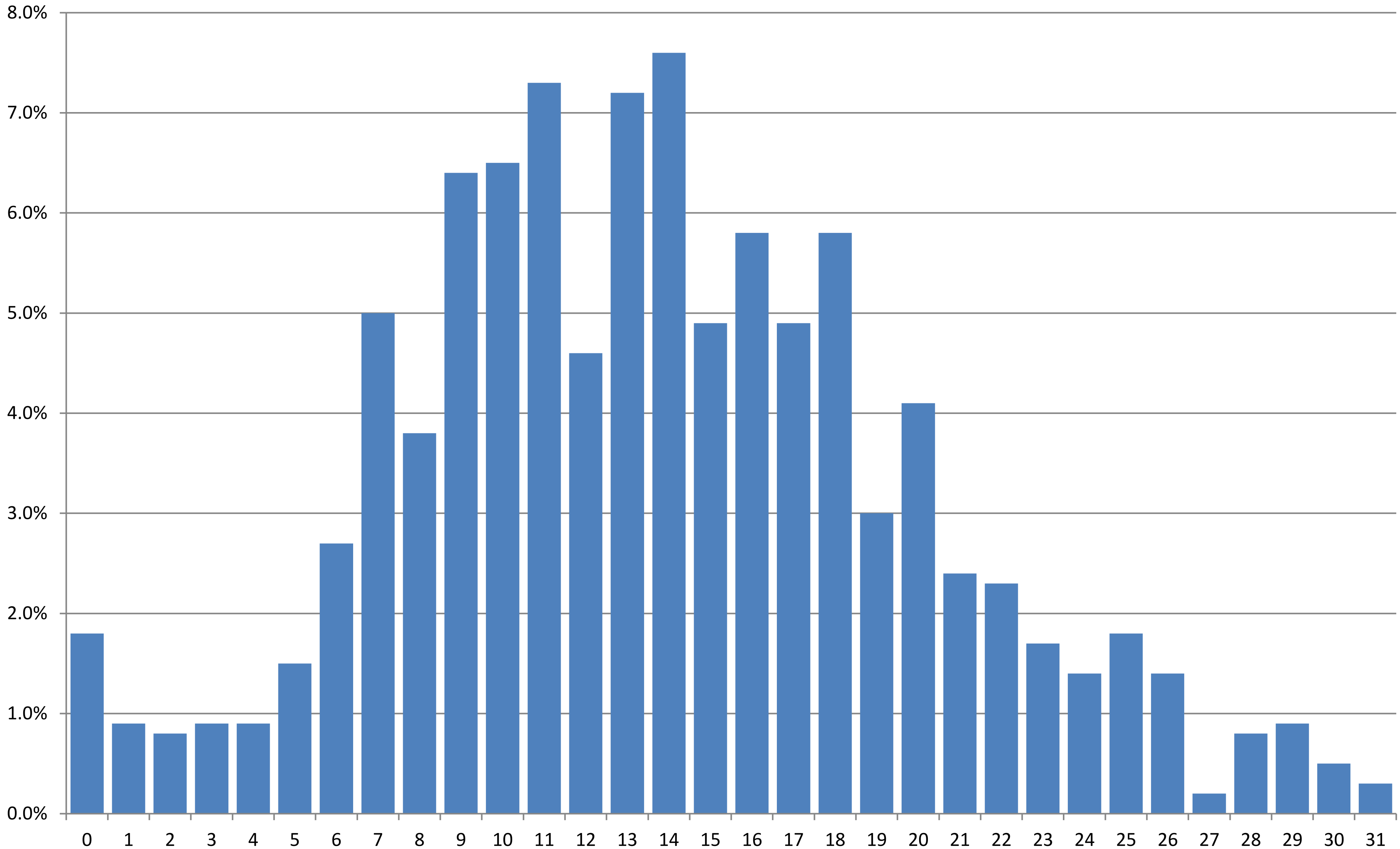
Which of the following services does your facility provide?



Number of Services Provided by Each Facility

	N	Valid Percent	Cumulative Percent
0	12	1.8%	1.8%
1	6	0.9%	2.7%
2	5	0.8%	3.5%
3	6	0.9%	4.4%
4	6	0.9%	5.3%
5	10	1.5%	6.8%
6	18	2.7%	9.6%
7	33	5.0%	14.6%
8	25	3.8%	18.4%
9	42	6.4%	24.8%
10	43	6.5%	31.4%
11	48	7.3%	38.7%
12	30	4.6%	43.2%
13	47	7.2%	50.4%
14	50	7.6%	58.0%
15	32	4.9%	62.9%
16	38	5.8%	68.6%
17	32	4.9%	73.5%
18	38	5.8%	79.3%
19	20	3.0%	82.3%
20	27	4.1%	86.5%
21	16	2.4%	88.9%
22	15	2.3%	91.2%
23	11	1.7%	92.8%
24	9	1.4%	94.2%
25	12	1.8%	96.0%
26	9	1.4%	97.4%
27	1	0.2%	97.6%
28	5	0.8%	98.3%
29	6	0.9%	99.2%
30	3	0.5%	99.7%
31	2	0.3%	100.0%
Total	657	100.00%	
Mean	**13.8** (*SD=6.2*)		
Percentiles	5th=4.0, 25th=10.0, 50th=13.0 75th=18.0, 95th=25.0		

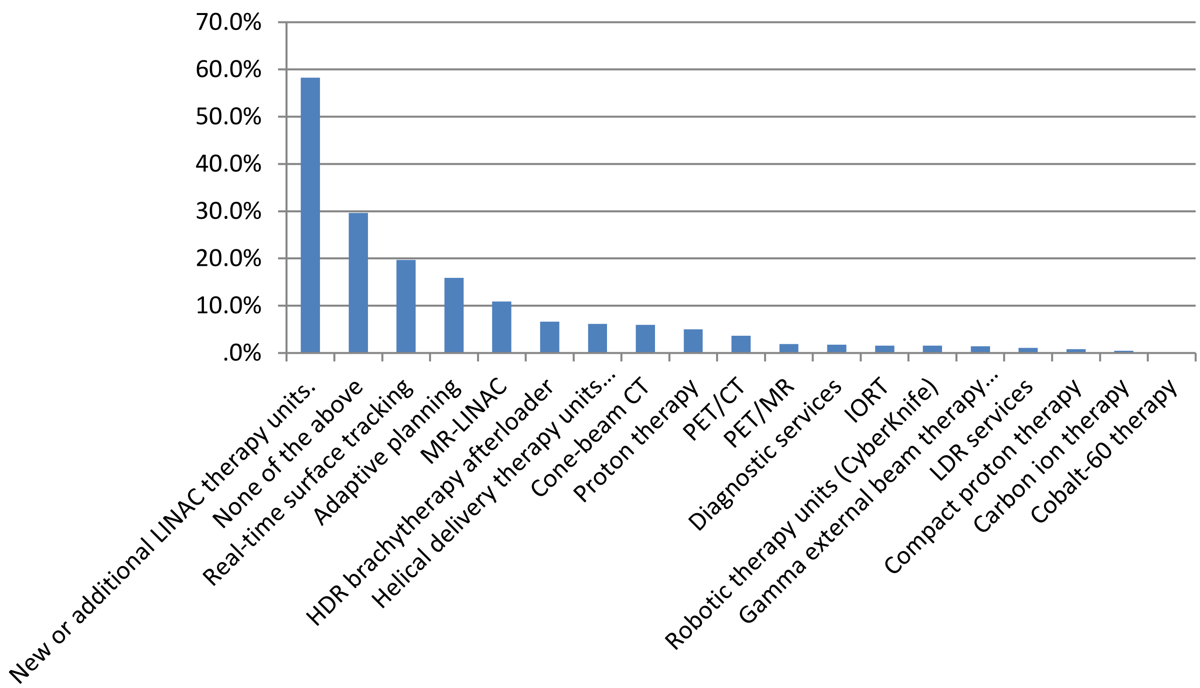
Number of Service Offered:



Over the next few years, is your facility planning to expand services to include any of the following?

	N	Percent of Cases
New or additional LINAC therapy units.	370	58.3%
None of the above	188	29.6%
Real-time surface tracking	125	19.7%
Adaptive planning	101	15.9%
MR-LINAC	69	10.9%
HDR brachytherapy afterloader	42	6.6%
Helical delivery therapy units (TomoTherapy, Halcyon, etc.)	39	6.1%
Cone-beam CT	38	6.0%
Proton therapy	32	5.0%
PET/CT	23	3.6%
PET/MR	12	1.9%
Diagnostic services	11	1.7%
IORT	10	1.6%
Robotic therapy units (CyberKnife)	10	1.6%
Gamma external beam therapy (GammaKnife, GammaPod, etc.)	9	1.4%
LDR services	7	1.1%
Compact proton therapy	5	0.8%
Carbon ion therapy	3	0.5%
Cobalt-60 therapy	1	0.2%

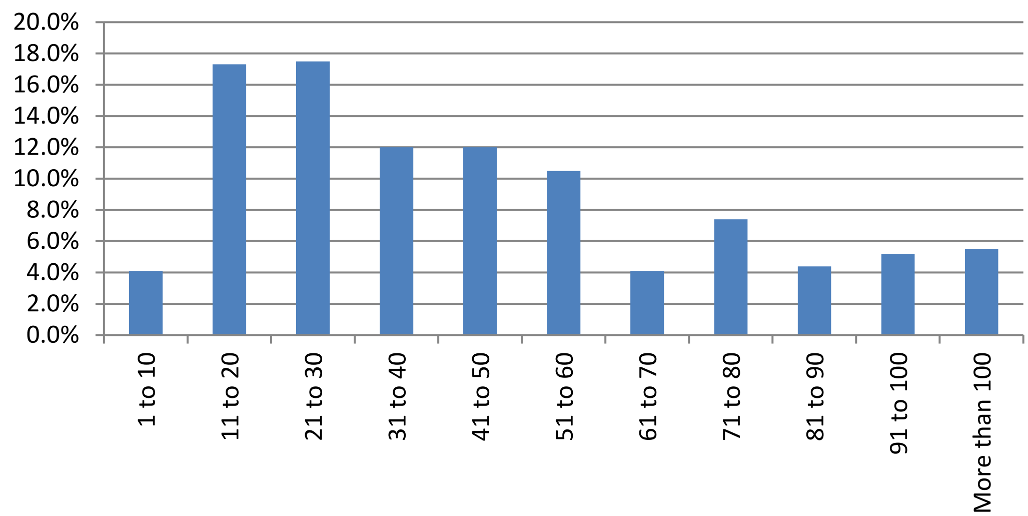
Over the next few years, is your facility planning to expand services to include any of the following?



On average, how many patients are treated daily at your facility?

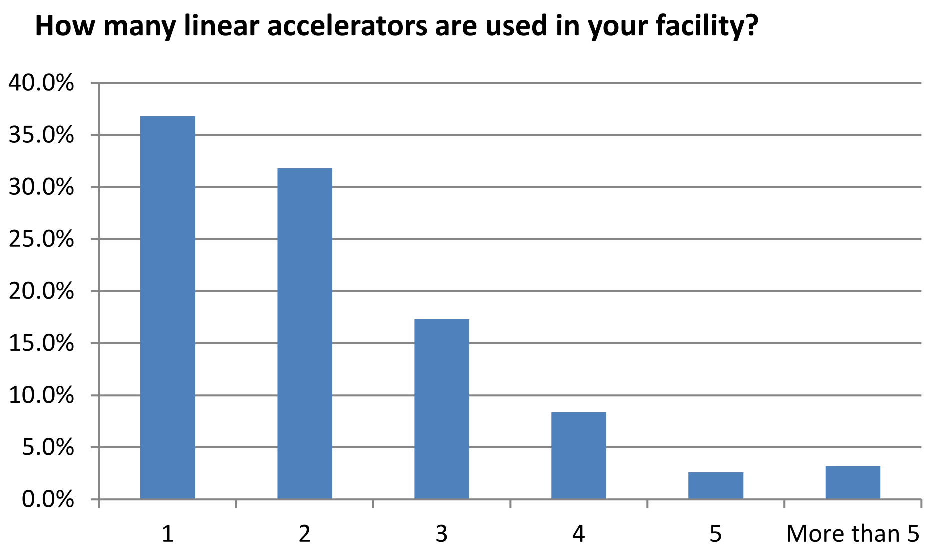
	N	Valid Percent	Cumulative Percent
1 to 10	22	4.1%	4.1%
11 to 20	94	17.3%	21.4%
21 to 30	95	17.5%	38.9%
31 to 40	65	12.0%	50.9%
41 to 50	65	12.0%	62.9%
51 to 60	57	10.5%	73.4%
61 to 70	22	4.1%	77.5%
71 to 80	40	7.4%	84.9%
81 to 90	24	4.4%	89.3%
91 to 100	28	5.2%	94.5%
More than 100	30	5.5%	100.0%
Total	542	100.0%	
Mean	**49.0** (*SD=31.0*)		
Percentiles	5th=12.0, 25th=25.0, 50th=40.0 75th=70.0, 95th=110.0		

On average, how many patients are treated daily at your facility?



How many linear accelerators are used in your facility?

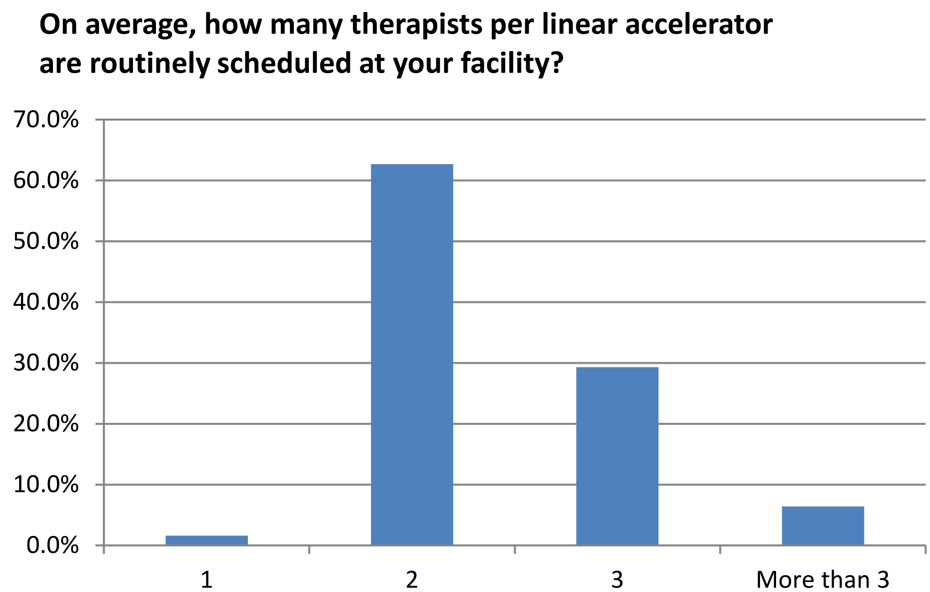
	N	Valid Percent	Cumulative Percent
1	198	36.8%	36.8%
2	171	31.8%	68.6%
3	93	17.3%	85.9%
4	45	8.4%	94.2%
5	14	2.6%	96.8%
More than 5	17	3.2%	100.0%
Total	**538**	**100.0%**	
Mean	**2.2** (*SD=1.3*)		
Percentiles	5th=1.0, 25th=1.0, 50th=2.0 75th=3.0, 95th=5.0		



Personnel Demographics

On average, how many therapists per linear accelerator are routinely scheduled at your facility?

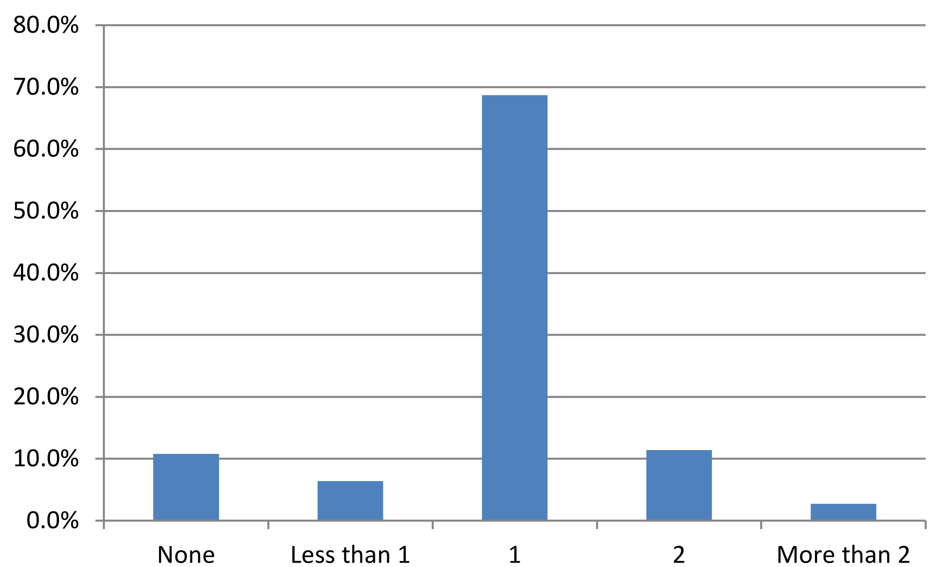
	N	Valid Percent	Cumulative Percent
1	8	1.6%	1.6%
2	313	62.7%	64.3%
3	146	29.3%	93.6%
More than 3	32	6.4%	100.0%
Total	499	100.0%	
Mean	**2.4** (*SD=0.6*)		
Percentiles	5th=2.0, 25th=2.0, 50th=2.0 75th=3.0, 95th=3.5		



On average, how many dosimetrists per linear accelerator are routinely scheduled at your facility?

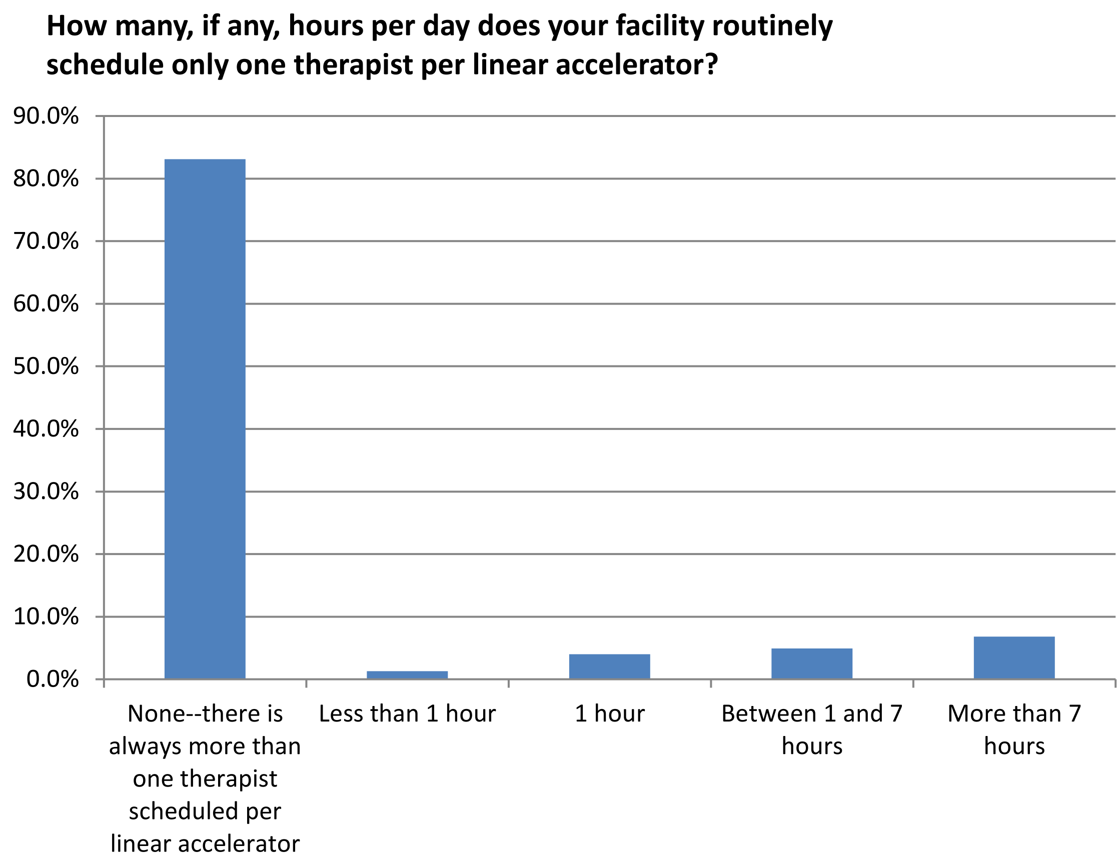
	N	Valid Percent	Cumulative Percent
0	52	10.8%	10.8%
Less than 1	31	6.4%	17.2%
1	332	68.7%	85.9%
2	55	11.4%	97.3%
More than 2	13	2.7%	100.0%
Total	483	100.0%	
Mean	**1.1** (*SD=0.6*)		
Percentiles	5th=0.0, 25th=1.0, 50th=1.0 75th=1.0, 95th=2.0		

On average, how many dosimetrists per linear accelerator are routinely scheduled at your facility?



How many, if any, hours per day does your facility routinely schedule only one therapist per linear accelerator?

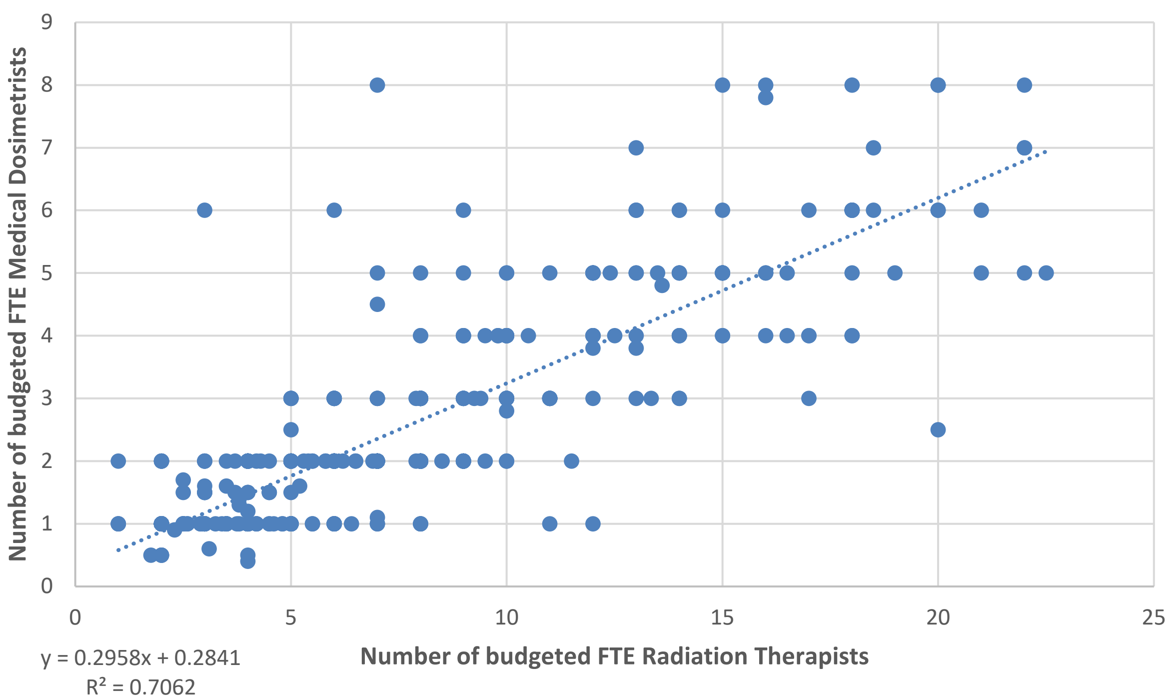
	N	Valid Percent	Cumulative Percent
None--there is always more than one therapist scheduled per linear accelerator	461	83.1%	83.1%
Less than 1 hour	7	1.3%	84.3%
1 hour	22	4.0%	88.3%
Between 1 and 7 hours	27	4.9%	93.2%
More than 7 hours	38	6.8%	100.0%
Total	555	100.0%	
Mean	**0.7** (*SD=2.1*)		
Percentiles	5th=0.0, 25th=0.0, 50th=0.0 75th=0.0, 95th=8.0		



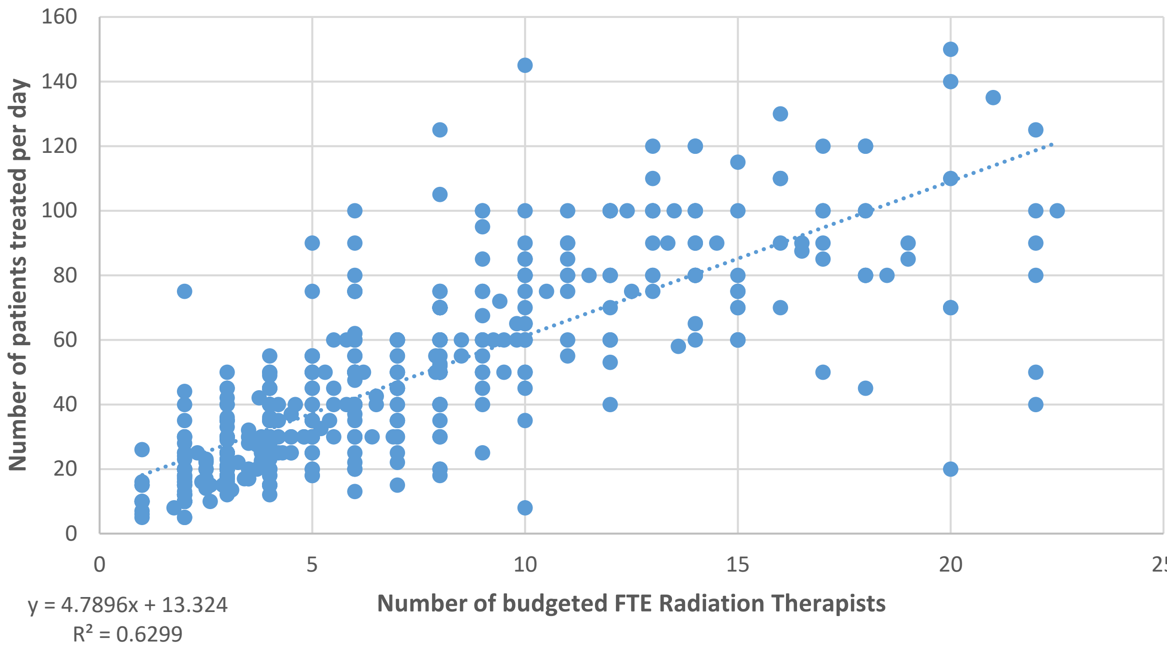
Appendix A. Scatterplots

Below are scatterplots that demonstrate the observed relationship between selected variables from the survey. Please note that these scatterplots do not necessarily demonstrate any causal relation. They merely show how the given factors measured in the survey vary from each other. In each instance below, one variable is treated as independent (charted on the x-axis) and another is treated as dependent (charted on the y-axis). The points on the chart represent each of the observed data points from the survey. The diagonal line running across the chart represents the best-fit straight line through the observed data points. This is derived from the regression equation in the lower left-hand corner of the chart. The r^2 measures the proportion of variance among the data points accounted for by the regression equation. The closer the r^2 is to 1, the better the line fits the data; the closer the r^2 is to 0, the more poorly the line fits the data. Also listed is the ratio of the variable on the x-axis to the variable on the y-axis.

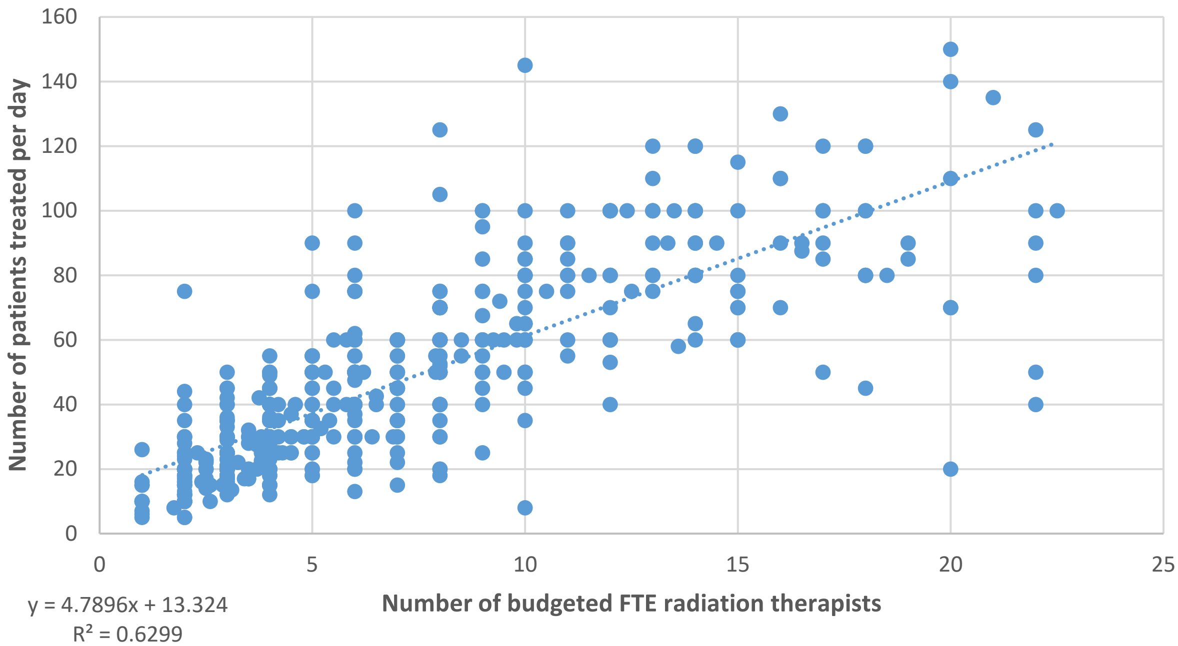
Number of Budgeted FTE Medical Dosimetrists per Facility by Number of Budgeted FTE Radiation Therapists per Facility



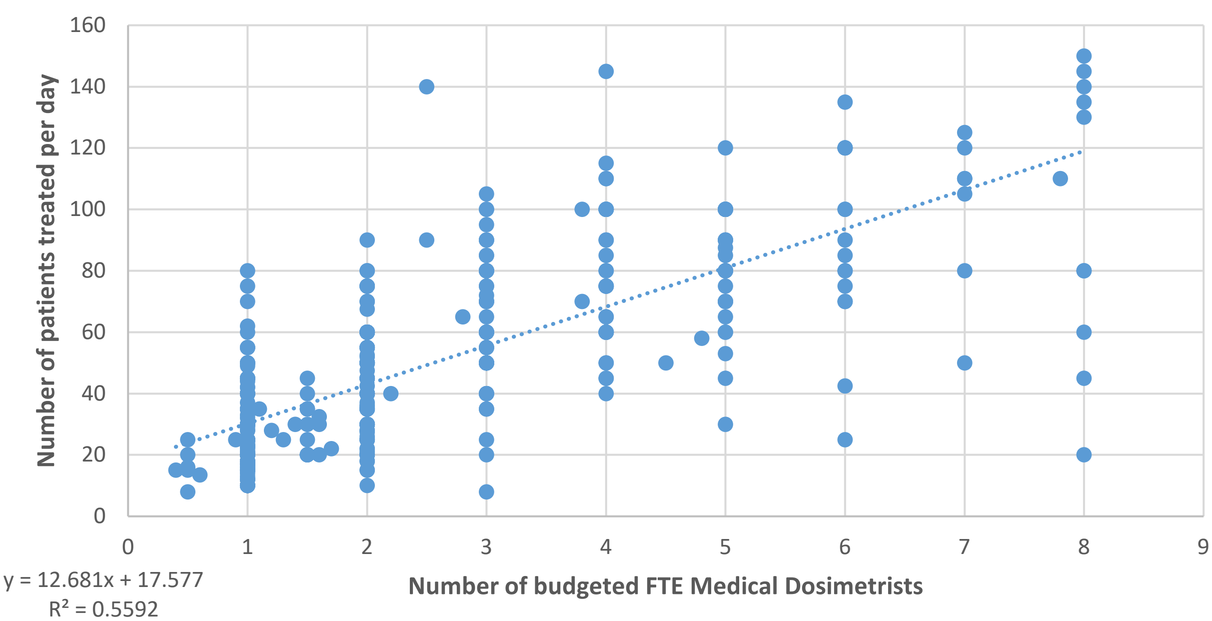
Number of Budgeted FTE Radiation Therapists per Facility by Number of Patients Treated per Day



Number of budgeted FTE radiation therapists per facility by number of patients treated per day



Number of Budgeted FTE Medical Dosimetrists per Facility by Number of Patients Treated per Day



ASCO special articles

Results From the ASCO 2019 Survey of Oncology Practice Operations

Brian Bourbeau, MBA[1]; David Harter, BS[1]; and Elaine Towle, CMPE[2]

abstract

The Survey of Oncology Practice Operations is an annual survey conducted by ASCO since 2016. This is the first year in which results have been published publicly for use by practice leaders to compare the performance of their practice. The scope of the 125-question survey instrument includes medical oncology, radiation oncology, drug administration, laboratory, imaging, point-of-care dispensing pharmacy, clinical research, and practice/service-line administration. Benchmarks available include measures of staffing, productivity, revenue, and expenses, as well as a salary survey for 27 oncology-specific positions. We encourage readers of this article to develop capabilities to replicate these benchmarks within their practice and to participate in future years' surveys.

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INTRODUCTION

Benchmarking to one's peers allows practices to compare performance, set goals, and identify opportunities to improve performance. ASCO operates two benchmarking programs for members and their practices: the Quality Oncology Practice Initiative includes more than 150 measures of quality care and patient safety, and PracticeNET supports practice health with a focus on operational metrics.

Each year, PracticeNET conducts the Survey of Oncology Practice Operations (SOPO), a 125-question survey covering operational metrics in hematology/oncology, radiation oncology, drug administration, laboratory, imaging, point-of-care pharmacy, and clinical research. Each response is reviewed to ensure completeness and subjected to data quality standards to ensure the validity of each benchmark. Successful participation in SOPO provides practice leaders access to 109 benchmarks of staffing, productivity, revenue, salaries, and other expenses.

METHODOLOGY

A total of 712 physician and administrative leaders were invited to participate in the survey, representing approximately 400 practices. Survey participants were identified through participation in one or more ASCO practice health and/or quality improvement programs, active members of ASCO with the membership type of Practice Administrator, and other leadership contacts gathered by ASCO staff.

Participants received e-mail invitations to the SOPO survey, which was made available from February 4, 2019 to March 15, 2019. Participants were asked to submit one response per practice, for the calendar year 2018. Participants who submitted partial or unclear responses received follow-up communications until such time that we received improved responses or believed additional contact was futile.

Participants were given multiple options to submit complete survey information. All survey questions were available online. Participants who were members of ASCO's PracticeNET collaborative—PracticeNET is a free benchmarking service available to ASCO members and their practices—had previously submitted monthly productivity information throughout 2018 and were not required to restate these numbers in the survey.

Quality Standards

We subjected each survey response to numerous quality checks. Among the 110 initial responses, we first identified 10 duplicates, which we either deleted or coalesced into a single result. Furthermore, we subjected all responses to the following tests to ensure data accuracy:

ASSOCIATED CONTENT
Appendix

See accompanying oncographic on page 249

Author affiliations and support information (if applicable) appear at the end of this article.

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TABLE 1. Accepted Survey Responses

Practice	Practice Type	State	Respondent
Arizona Oncology	Physician-owned practice	AZ	Paul Brosor
Bon Secours Hematology and Oncology	Hospital-owned practice	SC	Theresa Standifer
Cancer & Hematology Centers of West Michigan	Physician-owned practice	MI	Cindy Powers
Cancer Care Partnership	Hospital-owned practice	PA	Stephen Speece
Center for Cancer and Blood Disorders	Physician-owned practice	TX	Felicia Wheeler
Charleston Area Medical Center	Hospital-owned practice	WV	Beverly Farmer
Epic Care	Physician-owned practice	CA	Bill Murphy
Harbin Clinic	Physician-owned practice	GA	Janice Hopkins
Hematology Oncology	Other	CT	Judy Stone
Hematology Oncology Physicians of Englewood	Other	NJ	Cheryl Hodges
IHA Hematology Oncology Consultants	Other	MI	Anne Gentz
John B. Amos Cancer Center	Hospital-owned practice	GA	William Brouwer
Low Country Cancer	Physician-owned practice	GA	Jim Tucker
Marin Cancer Care	Physician-owned practice	CA	Harvey Bichkoff
McFarland Clinic	Hospital-owned practice	IA	Lynn Lanning
Mid-Florida Hematology and Oncology Centers	Physician-owned practice	FL	Harish Gowda
Minnesota Oncology	Physician-owned practice	MN	Rhonda Henschel
Montana Cancer Center at Providence St Patrick Hospital	Hospital-owned practice	MT	Kristy Beck-Nelson
Nebraska Hematology Oncology	Physician-owned practice	NE	Amy King
New England Cancer Specialists	Physician-owned practice	ME	Isabella Bouffard
New Hampshire Oncology	Physician-owned practice	NH	Dan Smith
Oncology Hematology Care	Physician-owned practice	OH	Abbey Cole
Oncology Specialties	Physician-owned practice	AL	Michelle Brown
OSF Saint Anthony Medical Center Patricia D Pepe Center for Cancer Care	Hospital-owned practice	IL	Thelma Baker
Pacific Shores Medical Group	Physician-owned practice	CA	Jim Mopsikoff
Providence Regional Cancer System Lacey	Hospital-owned practice	WA	Ryan Moore
Providence Cancer OR Region	Hospital-owned practice	OR	Courtney Wood
Providence St Mary Regional Cancer Center	Hospital-owned practice	WA	Hall Grimes
Queens Medical Associates	Physician-owned practice	NY	Sadiaka Joarder
Quincy Physicians & Surgeons Clinic	Physician-owned practice	IL	Melissa Bradfield
RCCA Center for Cancer and Blood Disorders	Physician-owned practice	MD	Carreen Huffman
Swedish Cancer Institute	Hospital-owned practice	WA	Selin Demir
Tennessee Oncology	Physician-owned practice	TN	Sharon Donatelli
The Christ Hospital Medical Specialists II	Hospital-owned practice	OH	Kristina Wilber
UNC REX Cancer Care	Hospital-owned practice	NC	Matthew Evans
University of Michigan Rogel Cancer Center	Academic practice	MI	Julie Brabbs
Ventura County Hematology Oncology Specialists	Physician-owned practice	CA	Lynn Kong
West Michigan Cancer Center	Other	MI	Sherry Hirst

- Participants reporting hematology/oncology services must have answered the question for the number of full-time equivalent (FTE) hematologist/oncologists or radiation oncologists.
- Practice-average work relative value units (wRVU) must have been reported and averaged between 2,500 and 18,000 per hematologist/oncologist or radiation oncologist.
- Practice-average new patient/consult visit counts must have been reported and averaged between 50 and 1,000 visits per hematologist/oncologist.
- Practice-average established patient visits must have been reported and averaged between 1,000 and 8,000 per hematologist/oncologist.

These quality standards are based on our prior survey and benchmarking experience. After application of these quality tests, we were left with 38 accepted responses, representing 638 FTE physicians. Certain benchmarks, such as staffing levels, staff pay, and other financials, required additional data. Some participants were excluded from one or more of these measures because of lack of sufficient information; the caption for each figure includes the number of practices and physicians represented.

Metrics

Most benchmarks were calculated on a per-physician basis. Participants were asked to report the number of FTE hematologists/oncologists (FTE HemOnc), radiation oncologists (FTE RadOnc), and other specialists for their practice on the basis of a standard of four clinic days per week, clinic business at least part of the fifth day, and shared call. Throughout the report, the value of 7,000 wRVUs is used to calculate a standardized hematologist/oncologist (STD HemOnc), an alternative denominator to FTE HemOnc. The benefit of the STD HemOnc denominator is that it equalizes staffing levels and expenses on the basis of a standard expectation of physician productivity. Benchmarks may be presented per FTE HemOnc, STD HemOnc, FTE RadOnc, and/or FTE physician.

Most benchmarks are calculated with their 25th, 50th, and 75th percentile, along with an unweighted average and a weighted adjusted average using a least squares method (adjusted average $= \frac{\sum_i \frac{n_i}{d_i}\sqrt{d_i}}{\sum_i \sqrt{d_i}}$). Throughout this article, use of this adjusted average is preferred when available.

Confidentiality

Confidentiality of practice and physician data is a key component of SOPO and other PracticeNET programs. SOPO reports are either reported by aggregation (such as this article) or using randomly generated practice keys. Care is taken not to identify individual data points by practice name or other identifying information, such as the raw number of physicians or geography.

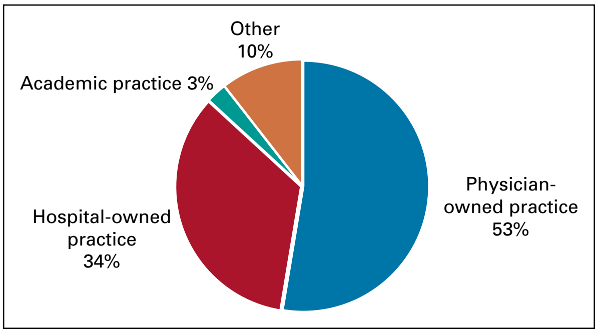


FIG 1. Accepted responses by practice type in 38 practices; full-time equivalent physicians (n = 637.6).

RESULTS

Demographics

Survey respondents reported their roles as either physician (3%), chief executive officer/executive director (13%), practice administrator/office manager (52%), director of finance (16%), or other (16%).

Among the 38 accepted responses, 20 were from physician-owned practices, 13 from nonacademic hospital-owned practices, one from an academic practice, and four reporting another arrangement (Table 1; Fig 1). These results diverge from prior surveys published by *JCO Oncology Practice*, which heavily favored physician-owned practices.[1] The diversity in practice setting is reflective of concerted outreach to a broad collection of practices and does not necessarily reflect a change in national practice demographics.

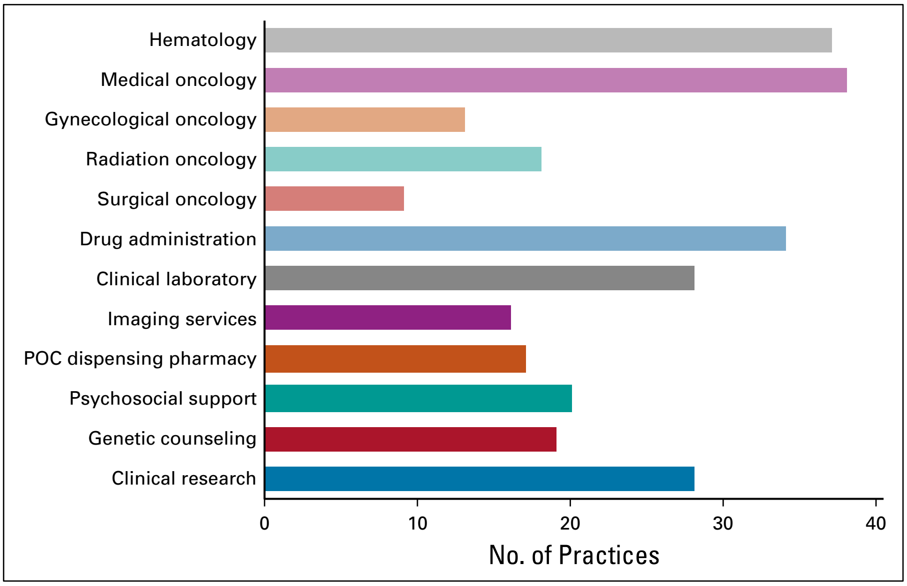


FIG 2. Number of practices (n = 38) offering specific services among full-time equivalent (FTE) physicians (n = 637.6). POC, point of care.

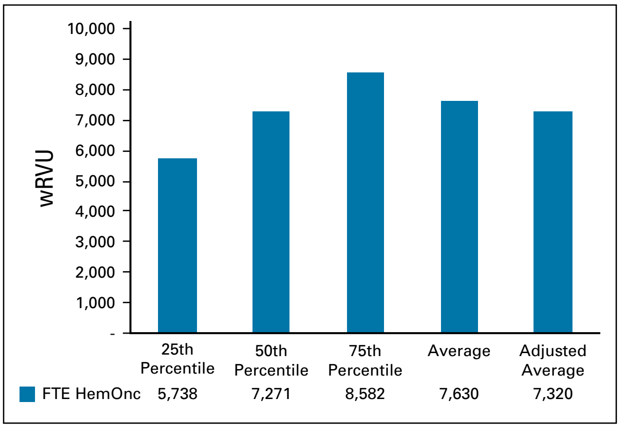


FIG 3. Work relative value units per full-time equivalent hematologist/oncologist (FTE HemOnc, n = 466) in 38 practices.

Practices reported an average of 12.3 hematologist/oncologists (Fig A1, online only) and, for those with radiation oncology services, an average of 5.8 radiation oncologists (Appendix Fig A2, online only). Respondents reported a variety of core and ancillary services offered by their practice (Fig 2).

Physician Productivity

The number of wRVUs reported per hematologist/oncologist is a principal productivity measure within the benchmark results. Within the resource-based relative value scale, each professional service is assigned a relative value unit for physician work (wRVU), practice expense, and professional liability insurance.[2] Health care organizations subscribe to these values—the Centers for Medicare & Medicaid Services publishes current amounts at least once per quarter—to calculate total wRVUs for compensation and other purposes.

Within the 38 responses successfully reporting productivity information for hematology/oncology, the interquartile range was 5,738 to 8,582 wRVUs, with an average of 7,320 per hematologist/oncologist (Fig 3). We did observe a difference in productivity levels on the basis of the reported practice type. Physician-owned practices reported an average of 7,673 wRVUs, whereas nonacademic hospital-owned practices reported an average of 7,123 wRVUs, all per FTE HemOnc.

Well-correlated to the overall level of wRVU-based productivity are the number of new patient/consult visits and established patient visits reported by participants. In this year's survey, the average of new patient/consult visits totaled 301 visits per FTE (Fig 4), whereas established patient visits (office visits for patients having previously been seen by the practice) had an average of 3,334 (Fig 5). We have observed that within our PracticeNET benchmarking collaborative, practices with higher performance in new patient/consult visits relative to average wRVUs experience future growth in overall productivity, whereas those with lower new patient/consult visits may experience future decline in overall productivity.

Although overall wRVUs were correlated to the number of visits, they were also influenced by differences in the levels of service reported for each visit type; each level of service is assigned a different wRVU value on the basis of the estimated time and complexity involved. Levels of service varied from practice to practice (Figs 6 and 7); for example, within new patient visits, the proportion of level five visits (99205) ranged from 2% to 89% of all new patient visits. Other visit measures include the number and distribution of hospital visits (including consults; Appendix Fig A3, online only), distribution of hospital visit levels of service (Appendix Figs A4 and A5, online only), and total number of

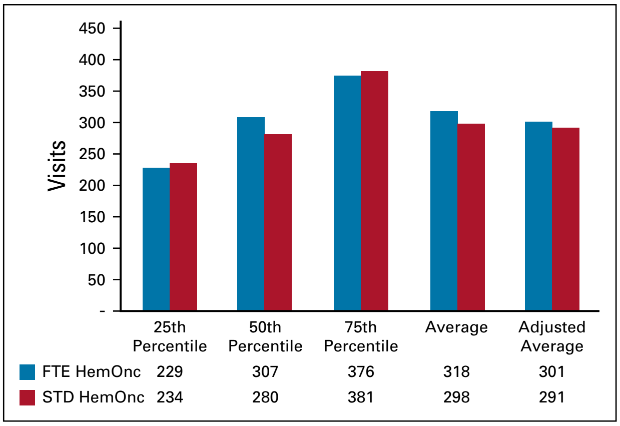
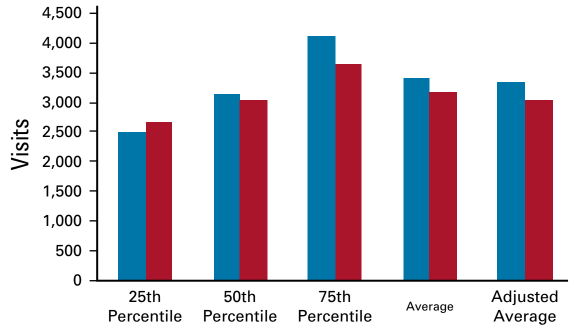
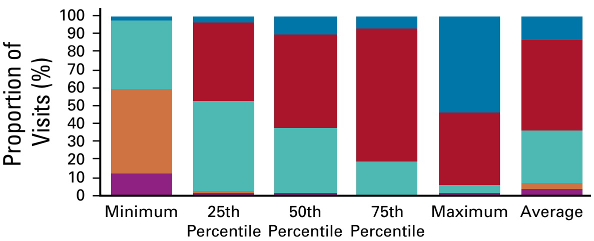


FIG 4. New patient/consult visits per hematologist/oncologist (HemOnc, n = 466) for billing codes 99201-99205, 99241-99245, and 99251-99255 in 38 practices. FTE, full-time equivalent; STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	2,489	3,121	4,107	3,403	3,334
STD HemOnc	2,662	3,027	3,634	3,170	3,052

FIG 5. Established patient visits per hematologist/oncologist (HemOnc, n = 466) for billing codes 99211-99215 in 38 practices; FTE, full-time equivalent; STD, standardized.



	Minimum	25th Percentile	50th Percentile	75th Percentile	Maximum	Average
99215	3%	4%	10%	7%	54%	13%
99214	0%	43%	53%	74%	40%	50%
99213	38%	50%	36%	19%	5%	29%
99212	46%	1%	0%	0%	0%	3%
99211	12%	1%	1%	0%	1%	4%

FIG 7. Level-of-service distribution among established patient visits for billing codes 99211-99215 in 38 practices; full-time equivalent hematologist/oncologists (n = 466).

evaluation and management visits per hematologist/oncologist (Appendix Fig A6, online only).

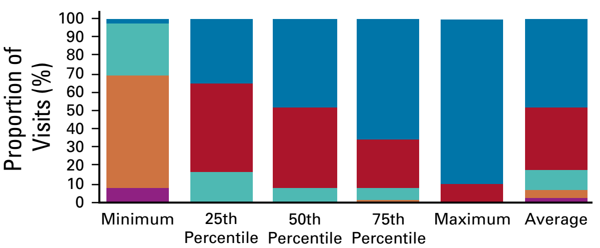
Within radiation oncology, respondents reported markedly higher number of wRVUs per radiation oncologist, with an average of 11,955 (Fig 8). Radiation oncologists averaged 204 new patient/consult visits for the year (Fig 9). Rather than reporting established patient visits, many of which are bundled into a 90-day global billing period for radiation oncology, we have included a benchmark for the number of radiation management services, with an average of 954 (Appendix Fig A7, online only). Although the wRVU and new patient/consult visit measures are used for both hematology/oncology and radiation oncology, we draw no conclusions about the differing productivity levels and caution against such comparisons among specialties.

Staffing and Equipment

Hematology/oncology staffing benchmarks are primarily described as the number of FTE staff per standardized hematologist/oncologist, a method that allows for adjustment due to differing physician productivity levels. Twenty-nine of the 38 total survey responses included staff FTEs for hematology/oncology. Staffing measures were handled using the following rules:

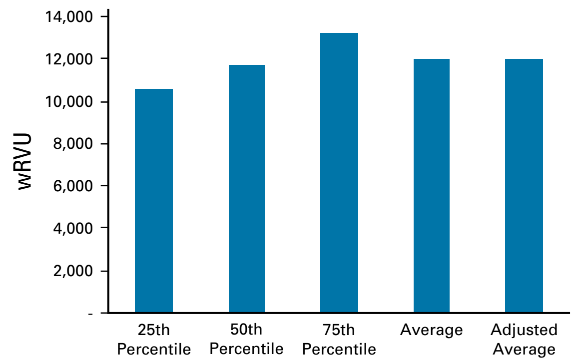
- Responses that failed to include staffing information were excluded from all staffing measures.
- Responses that indicated that the practice did not provide certain services were excluded in applicable measures. For example, if a practice indicated that they did not provide clinical research, they were excluded from the research nurse measure.

Staffing measures are organized into clinical support of the hematologist/oncologist (Fig 10; Appendix Figs A8-A10, online only), drug administration (Figs 11-13; Appendix Figs A11-A17, online only), radiation oncology (Figs 14-16; Appendix Figs A18-A25, online only), other ancillary services (Appendix Figs A26-A30, online only), and administrative staff (Appendix Figs A31-A38, online only). We report the number of clinical staff assisting the hematologist/oncologist in patient evaluation and care management,



	Minimum	25th Percentile	50th Percentile	75th Percentile	Maximum	Average
99205	2%	35%	49%	66%	89%	48%
99204	0%	48%	43%	26%	10%	34%
99203	28%	16%	8%	6%	0%	11%
99202	62%	0%	0%	1%	0%	5%
99201	8%	0%	0%	0%	0%	2%

FIG 6. Level-of-service distribution among new patient visits for billing codes 99201-99205 in 38 practices; full-time equivalent hematologist/oncologists (n = 466).



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE RadOnc	10,561	11,695	13,223	12,020	11,955

FIG 8. Work relative value units (wRVU) per radiation oncologist (RadOnc, n = 44.8) in 10 practices. FTE, full-time equivalent.

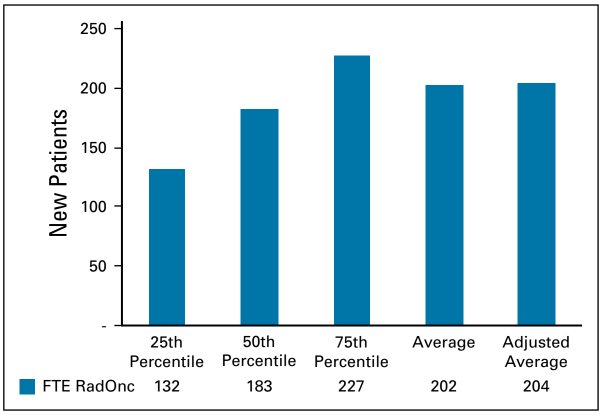


FIG 9. New patient/consult visits per full-time equivalent radiation oncologist (FTE RadOnc, n = 44.8) for billing codes 99201-99205, and 99241-99245 in 10 practices.

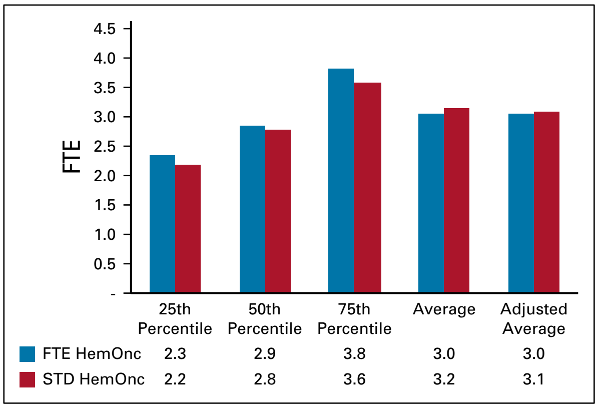


FIG 11. Drug administration staff per hematologist/oncologist (HemOnc, n = 310.5) in 21 practices. FTE, full-time equivalent; STD, standardized.

advanced practice providers (APPs; average per STD HemOnc, 0.7; Fig 10), nurses (other than drug administration; 0.6; Appendix Fig A8), and medical assistants (1.4; Appendix Fig A9). Less-often reported positions included social workers (present in 14 practices; < 0.1-0.7 per STD HemOnc), genetic counselors (9 practices; < 0.1-0.3), nutritionists (7 practices; < 0.1-0.3), and other clinical support (15 practices; < 0.1-1.1). At an average salary of $108,809, APPs represented a significant investment for practices. Few responses included productivity information for this position; those who did averaged 2,027 wRVUs per APP (Appendix Fig A10).

Drug administration staff represented the second highest category of staffing expense, with an average of 3.1 FTE per STD HemOnc (Fig 11). Such positions included nurses (average per STD HemOnc, 2.2), pharmacists and technicians (0.6), and other drug administration staff (0.2; Appendix Fig A11). Respondents also reported their number of drug administration chairs, which averaged 5.9 chairs per STD HemOnc (Fig 12). The ratio of drug administration staff to chair averaged 0.5, the inverse of which is 2 chairs per drug administration staff (Appendix Fig A12).

Productivity of the drug administration unit is reported in this year's survey in a number of benchmarks. Benchmarks include the number of initial intravenous infusions/injections and total number of drug administration services per STD HemOnc (1,496 and 5,703, respectively; Appendix Figs A13 and A14), per drug administration staff (538 and 2,075; Appendix Figs A15 and A16), and per chair (264 and 1,052; Fig 13 and Appendix Fig A17).

Similar measures are reported for radiation oncology. Total clinical support staff averaged 5.9 FTE per radiation oncologist (Fig 14), made up of 0.9 nurses (Appendix Fig A18), 0.3 medical assistants (Appendix Fig A19), 2.8 radiation therapists (Appendix Fig A20), and 1.6 physics staff (Appendix Fig A21), equally divided between physicists and dosimetrists. Radiation-specific APPs were reported by only one practice.

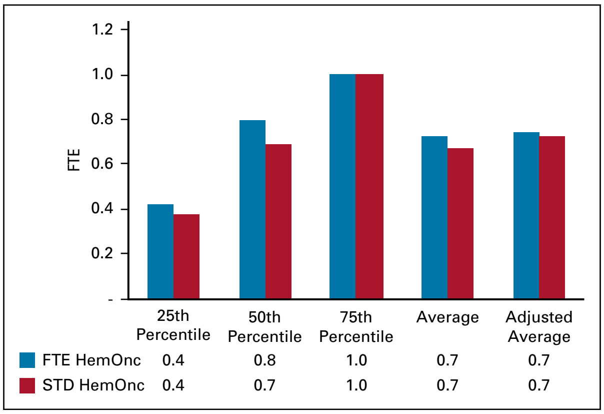


FIG 10. Hematology/oncology advanced practice providers per hematologist/oncologist (HemOnc, n = 364.3) in 29 practices. FTE, full-time equivalent.

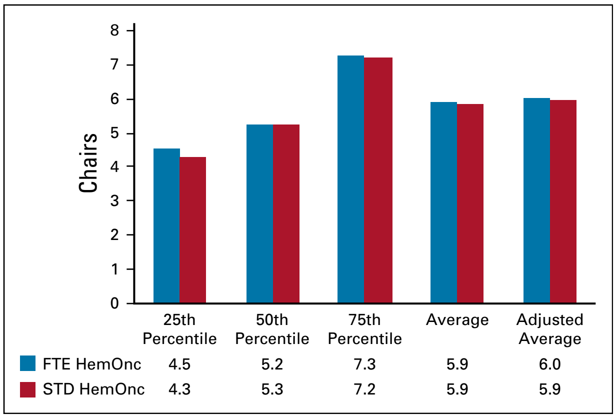


FIG 12. Drug administration chairs per hematologist/oncologist (HemOnc, n = 310.5) in 21 practices. FTE, full-time equivalent; STD, standardized.

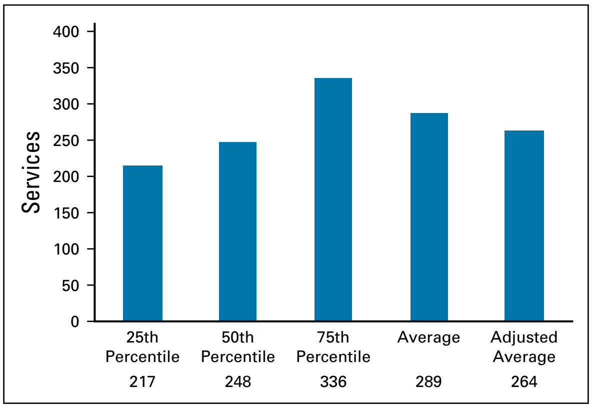


FIG 13. Initial intravenous infusion services per drug administration chair for billing codes 96360, 96365, 96374, 96409, and 96413 in 21 practices. Full-time equivalent hematologist/oncologists (n = 310.5).

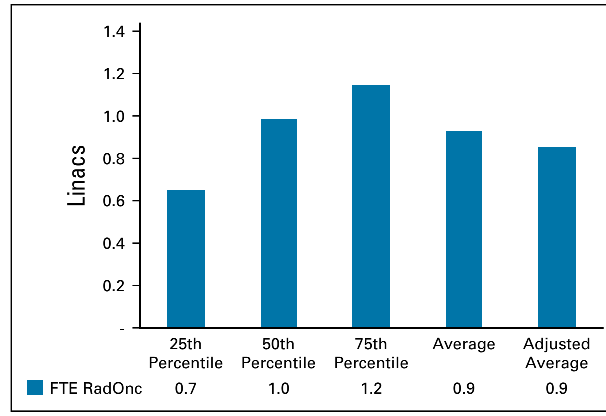


FIG 15. Linear accelerators (Linacs) per full-time equivalent radiation oncologist (FTE RadOnc, n = 32.8) in 7 practices.

Linear accelerators and their associated equipment present a high fixed cost for radiation oncology, with an average investment of $4.1 million (calculated from equipment expense survey data assigned to radiation treatment procedures[3]). An average of 0.9 linear accelerators were reported per FTE radiation oncologist (Fig 15), staffed by 3.3 radiation therapists each (Appendix Fig A22). The number of annual external beam radiation treatments (EBRT) per linear accelerator had an interquartile range of 4,002-7,213, with an average of 5,237 (Fig 16). EBRT is also reported per FTE radiation oncologist (4,197; Appendix Fig A23) and FTE radiation therapist (1,578; Appendix Fig A24). EBRT was reported for multiple treatment modalities, including conventional/conformal treatments (45.9%), intensity-modulated radiation treatments (51.6%), stereotactic body radiation therapy (2.4%), and stereotactic radiosurgery (0.1%; Appendix Fig A25).

Ancillary staffing included in this year's survey include clinical laboratory staff (0.6 per FTE physician; Appendix Fig A26), imaging staff (0.3; Appendix Fig A27), and point-of-care dispensing pharmacy staff (0.3; Appendix Fig A28). Clinical research staff ranged from 0.4-0.8 per physician (interquartile), with an average of 0.6 per FTE physician (Appendix Fig A29); these measures are also reported by FTE HemOnc and STD HemOnc. Research staff consisted of research nurses (0.2 per FTE physician), data managers (0.3), and administrative staff (0.1; Appendix Fig A30). Although the staffing measures reflect a meaningful cost to ancillary services, other costs, such as laboratory reagents and imaging equipment, were not surveyed.

Administrative staff averaged 3.3 FTE per physician (Appendix Fig A31), the largest category of which was front desk (1.0; Appendix Fig A32) and billing staff (1.3; Appendix Fig A33). Within the billing staff, special attention is paid to financial advocates charged with addressing patient out-of-pocket expenses (0.2 per FTE physician; Appendix Fig A34) and staff responsible for managed care authorization of diagnostic and therapeutic orders (0.3 average; Appendix Fig A35). The productivity of billing staff is also reported as annual collections per FTE billing staff

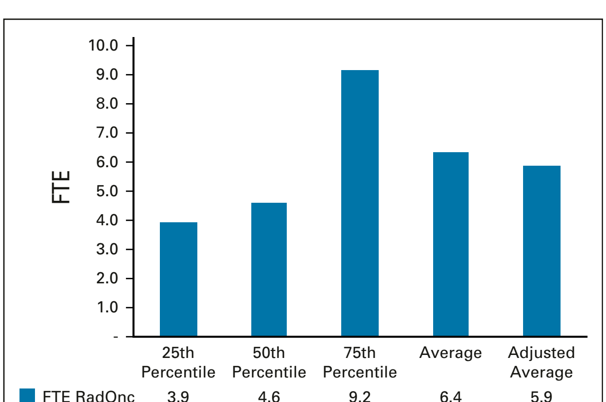


FIG 14. Clinical support staff per full-time equivalent radiation oncologist (FTE RadOnc, n = 32.8) in 7 practices.

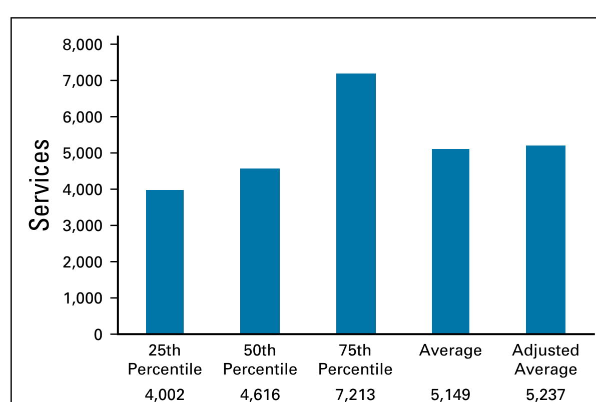


FIG 16. External beam radiation treatments per linear accelerator in 7 practices; full-time equivalent radiation oncologists (FTE RadOnc, n = 32.8).

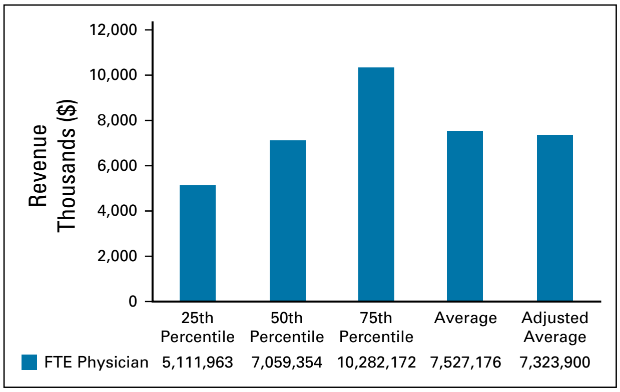


FIG 17. Total practice revenue per full-time equivalent (FTE) physician (n = 374.8) in 18 practices.

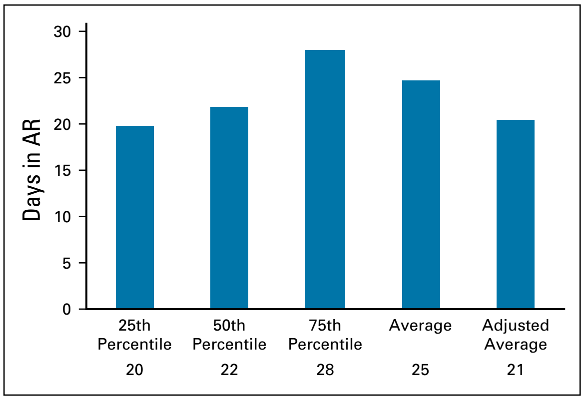


FIG 19. Year-end business days of revenue in accounts receivable (AR) in 14 practices; full-time equivalent physicians (n = 297.4).

($5,404,174; Appendix Fig A36). Other administrative positions include executive staff (0.2 per FTE physician; Appendix Fig A37), other managers (0.3; Appendix Fig A38), and other administrative support (0.7).

Revenue and Expenses

Total revenue and expense (including physician salaries) per FTE physician are reported in the survey ($7,323,900 and $7,261,026, respectively; Figs 17 and 18), though differing services per practice make comparison difficult. Therefore, we have presented these measures per service category to allow readers to use measures meaningful to their practice setting. Evaluation and management revenue within hematology/oncology averaged $487,251 per STD HemOnc (Appendix Fig A39, online only). Drug administration revenue averaged $391,626 (Appendix Fig A40, online only), set against direct staffing expense of $188,397 (Appendix Fig A41, online only) and supply expense of $72,906 per STD HemOnc (Appendix Fig A42, online only). Drug revenue, before accounting for cost of goods sold (drug cost), averaged $5,709,846 per STD HemOnc (Appendix Fig A43, online only) and has been increasing over the past 3 years within the ASCO PracticeNET program. Drug expense for administered drugs averaged $5,121,744 (Appendix Fig A44, online only), with drug revenue net of expense averaging $982,079 per STD HemOnc (Appendix Fig A45, online only).

Radiation revenue represented a significant nondrug revenue source for practices with radiation oncology services, averaging $2,967,442 per FTE radiation oncologist (Appendix Fig A46, online only), with an average of $584,128 per radiation oncologist in staff expense (Appendix Fig A47, online only).

Within ancillary services, clinical laboratory revenue averaged $103,639 (Appendix Fig A48, online only), against $29,805 in staffing expense per FTE physician (Appendix Fig A49, online only); imaging revenue averaged $190,500 (Appendix Fig A50, online only), with $35,399 in staffing expense per FTE physician (Appendix Fig A51, online only). Point-of-care dispensing pharmacy revenue averaged $1,843,342 (Appendix Fig A52, online only), with drug expense of $1,685,257 (Appendix Fig A53, online only), revenue net of drug expense of $157,084 (Appendix Fig A54, online only), and staffing expense of $21,098 per FTE physician (Appendix Fig A55, online only). Practices with clinical

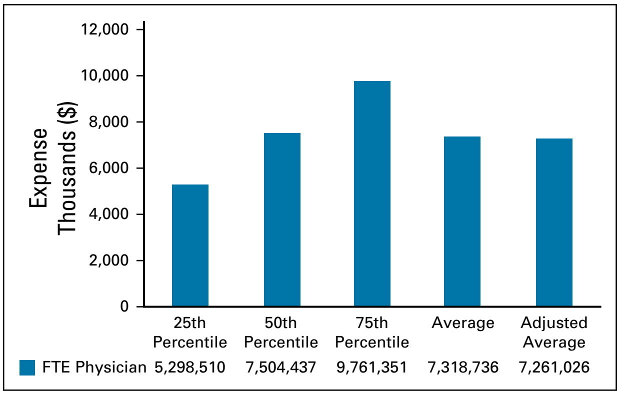


FIG 18. Total practice expense per full-time equivalent (FTE) physician (n = 353.7) in 16 practices.

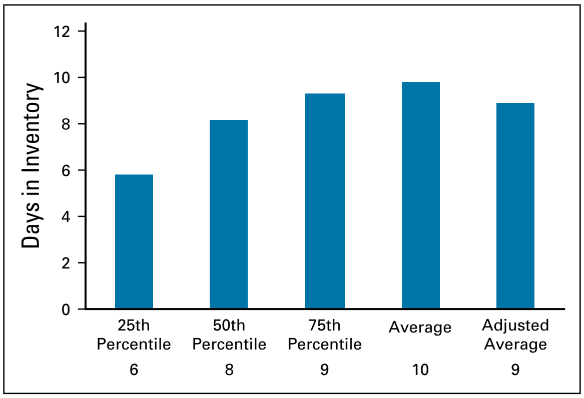


FIG 20. Year-end business days of drug revenue in inventory in 15 practices full-time equivalent hematologist/oncologists (n = 239.1).

TABLE 2. Salary Results

Position (No. practices)	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
Advanced practice provider (medical; 23)	94,892	110,169	119,216	108,807	108,809
Nurse navigator/clinician (medical; 11)	61,763	69,575	84,947	71,677	71,578
Medical assistant (medical; 25)	31,387	36,201	43,884	38,500	37,301
Social worker (13)	57,744	64,401	82,513	70,141	71,647
Genetic counselor (7)	75,058	85,476	100,889	90,179	84,038
Nutritionist (6)	50,575	57,716	75,010	61,404	62,521
Drug administration, nurse (18)	62,409	77,051	89,120	76,090	75,000
Drug administration, pharmacy (20)	52,969	66,805	95,890	78,988	77,449
Drug administration, other (11)	32,791	45,464	53,437	53,122	50,480
Nurse navigator/clinician (radiation; 7)	56,887	61,842	74,203	63,039	63,580
Medical assistant (radiation; 5)	21,506	32,619	40,535	31,340	32,928
Radiation therapist (8)	73,866	77,954	83,535	83,009	83,431
Medical physicist (7)	193,818	206,276	231,062	209,716	209,672
Dosimetrist (7)	98,781	101,307	131,742	114,148	115,263
Laboratory staff (18)	44,242	55,289	62,326	54,197	52,139
Imaging staff (6)	73,806	80,627	92,949	81,842	76,488
Point-of-care pharmacy, pharmacist (9)	105,835	127,278	137,950	124,584	122,578
Point-of-care pharmacy, other (7)	37,033	38,351	47,098	45,938	43,240
Clinical research, nurse (10)	62,743	71,588	95,174	76,993	77,582
Clinical research, data management (14)	46,984	50,000	56,851	56,022	51,855
Clinical research, administration (14)	52,337	58,594	74,506	69,047	67,122
Executive (18)	139,849	175,786	297,597	230,667	242,055
Other managers (20)	62,102	87,394	98,071	81,778	80,986
Front desk (24)	30,917	35,192	42,775	37,103	37,779
Financial advocate (20)	37,648	42,022	48,038	42,219	42,613
Authorization (5)	17,156	29,600	68,312	40,107	33,586
Other billing staff (22)	39,653	43,177	52,129	45,015	44,523

NOTE. Data given in $.

research units reported an average revenue of $49,140 (Appendix Fig A56, online only) and staffing expense of $30,103 per FTE physician (Appendix Fig A57, online only).

Key overhead expenses included administrative staff expense of $185,776 (Appendix Fig A58, online only), direct information technology expense of $52,675 (Appendix Fig A59, online only), and facility expense of $169,902 per FTE physician (Appendix Fig A60, online only). Practices reported carrying costs of $632,483 in accounts receivable (21 business days; Fig 19; Appendix Fig A61, online only) and $191,688 in drug inventory per FTE physician at the end of 2018 (9 business days; Fig 20; Appendix Fig A62, online only).

Salary Survey

Table 2 includes salary results for 27 oncology positions for which ASCO has received at least five responses for wages and FTE staff. In some positions we have found high variation in rates—drug administration pharmacy staff had an interquartile difference of $42,921—which may be indicative of poor definition in the associated questions. These questions have been flagged for refinement in future surveys.

In conclusion, the SOPO provides oncology practices in all practice settings with an important and unique tool to measure their operations. This year's results are a much-needed update to the literature. We intend to repeat this survey annually to provide additional practices an opportunity to participate and to provide the community current benchmarks and trends. Continuation of the survey will also provide an opportunity to explore additional metrics and analyses on the basis of these results and community feedback.

The 62% of practice responses not accepted are demonstrative of the difficulty in gathering key data on oncology practice operations. These practices may benefit from participation in ASCO's PracticeNET program, which provides practices numerous productivity, revenue, and value-based care measures on a quarterly basis. We encourage all practices to consider how they measure their operations and identify meaningful benchmarks to support goal setting and improvement activities.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST AND DATA AVAILABILITY STATEMENT

Disclosures provided by the authors and data availability statement (if applicable) are available with this article at DOI https://doi.org/10.1200/OP.20.00009.

AUTHOR CONTRIBUTIONS

Conception and design: All authors
Administrative support: Brian Bourbeau, David Harter
Collection and assembly of data: Brian Bourbeau, David Harter
Data analysis and interpretation: Brian Bourbeau, David Harter
Manuscript writing: All authors
Final approval of manuscript: All authors
Accountable for all aspects of the work: All authors

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Results From the ASCO 2019 Survey of Oncology Practice Operations

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated unless otherwise noted. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/op/authors/author-center.

Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians (Open Payments).

Elaine Towle
Employment: Elaine Towle Consulting

No other potential conflicts of interest were reported.

APPENDIX

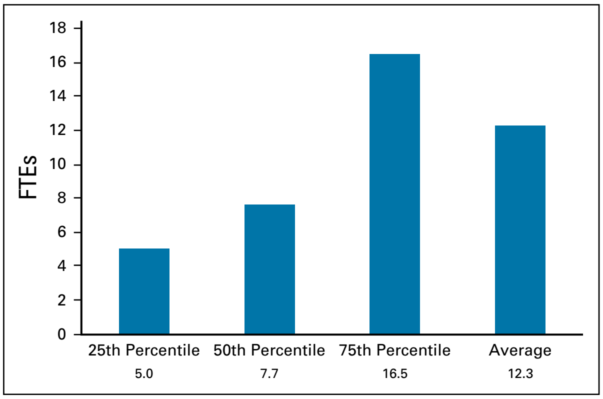


FIG A1. Total hematologist/oncologists per practice in 38 practices; full-time equivalent (FTEs) hematologist/oncologists (n = 466).

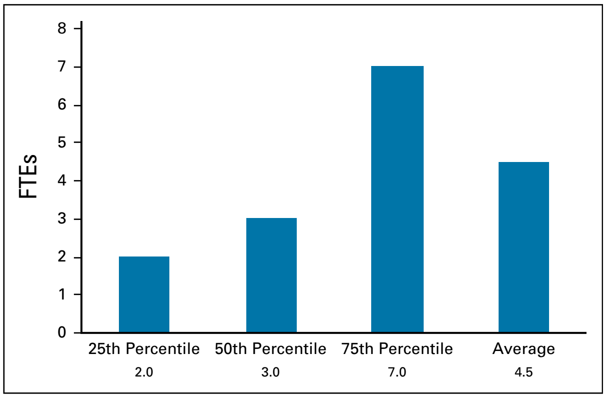
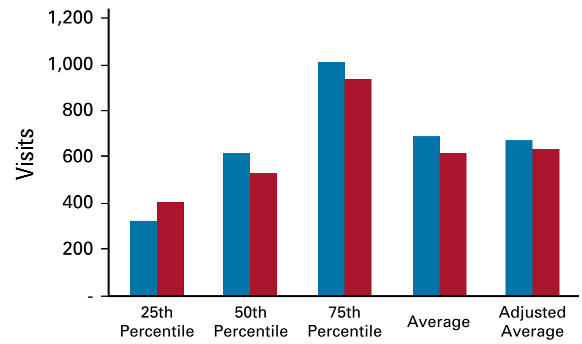
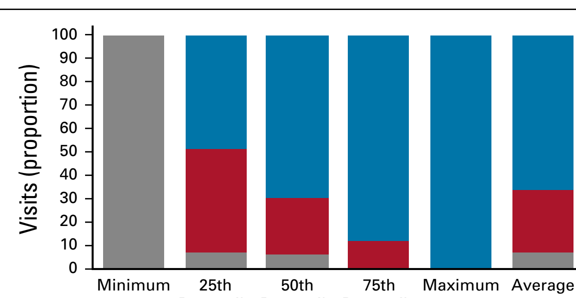


FIG A2. Total radiation oncologists per practice in 10 practices; full-time equivalent (FTEs) radiation oncologists (n = 44.8).



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	324	619	1,010	687	673
STD HemOnc	406	532	937	617	636

FIG A3. Hospital visits per hematologist/oncologist (HemOnc, n = 466) for billing codes 99217-99223, 99231-99236, 99238, 99239, and 99251-99255 in 18 practices; FTE, full-time equivalent; STD, standardized.



	Minimum	25th Percentile	50th Percentile	75th Percentile	Maximum	Average
99223	0%	49%	69%	87%	100%	66%
99222	0%	43%	24%	12%	0%	27%
99221	100%	8%	7%	1%	0%	7%

FIG A4. Level-of-service distribution among initial hospital care visits for billing codes 99221-99223 in 38 practices; full-time equivalent hematologist/oncologists (n = 466).

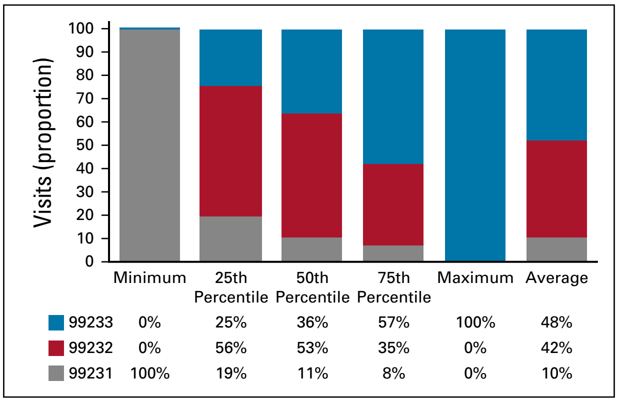


FIG A5. Level-of-service distribution among subsequent hospital care visits for billing codes 99231-99233 in 38 practices; full-time equivalent hematologist/oncologists (FTE HemOnc, n = 466).

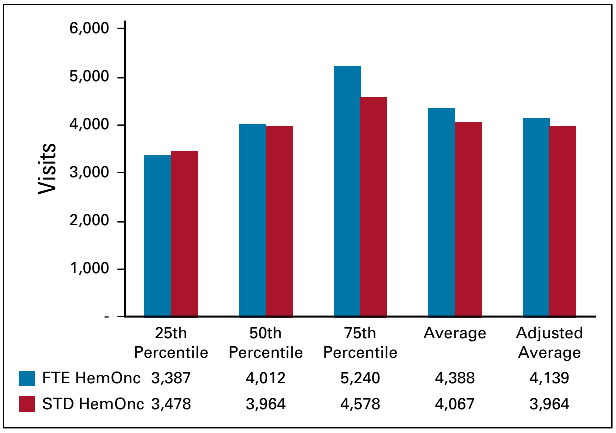


FIG A6. Total evaluation and management visits per hematologist/oncologist (HemOnc, n = 466) for billing codes 99201-99205, 99211-99215, 99217-99223, 99231-99236, 99238, 99239, 99241-99245, and 99251-99255 in 38 practices. FTE, full-time equivalent; STD, standardized.

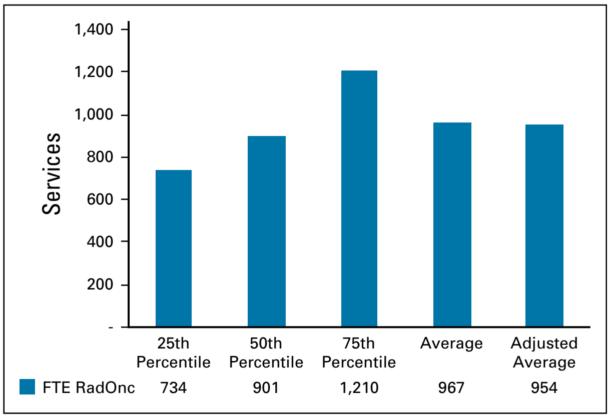


FIG A7. Radiation management services per full-time equivalent radiation oncologist (FTE RadOnc; n = 44.8) for billing codes 77427, 77431, 77432, 77435, and 77469 in 10 practices.

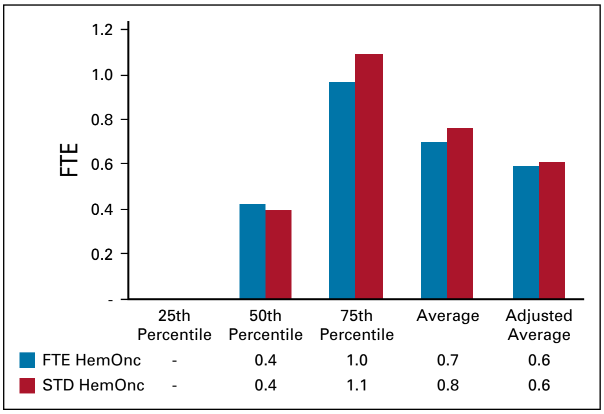


FIG A8. Hematology/oncology nurses, other than drug administration, per hematologist/oncologist (HemOnc, n = 364.3) in 29 practices. FTE, full-time equivalent; STD, standardized.

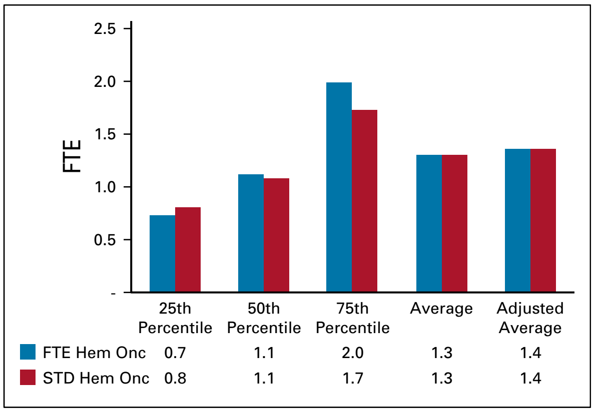


FIG A9. Hematology/oncology medical assistants, per hematologist/oncologist (HemOnc, n = 364.3) in 29 practices. FTE, full-time equivalent; STD, standardized.

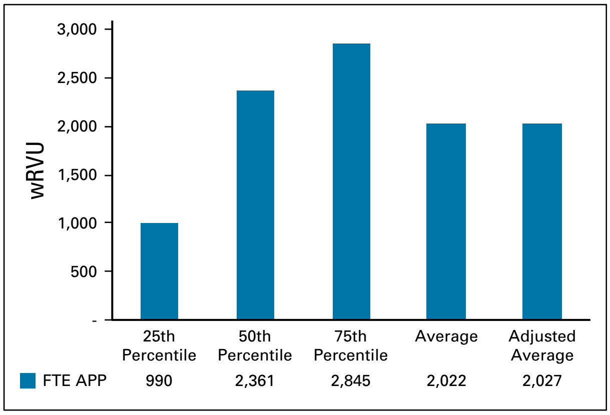


FIG A10. Work relative value units (wRVU) per full-time equivalent (FTE) hematology/oncology advanced practice provider (APP, n = 114.4) in 8 practices.

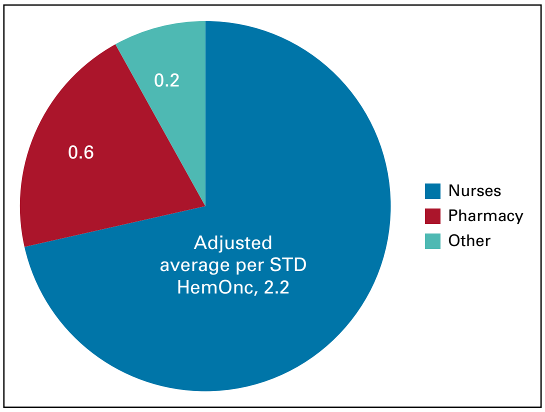


FIG A11. Classification of drug administration staff per full-time equivalent hematologist/oncologist (HemOnc, n = 310.5) in 21 practices. STD, standardized

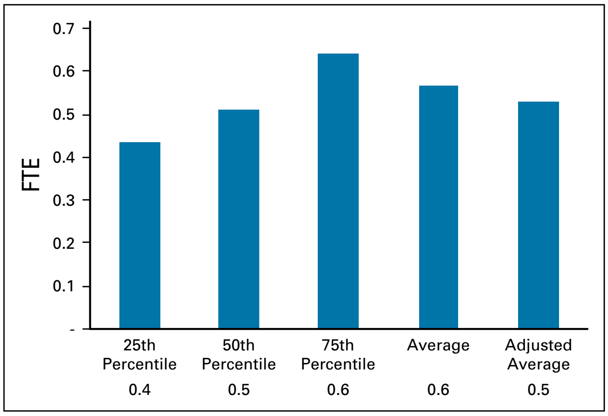


FIG A12. Drug administration staff per drug administration chair in 21 practices; full-time equivalent (FTE) hematologist/oncologists (n = 310.5).

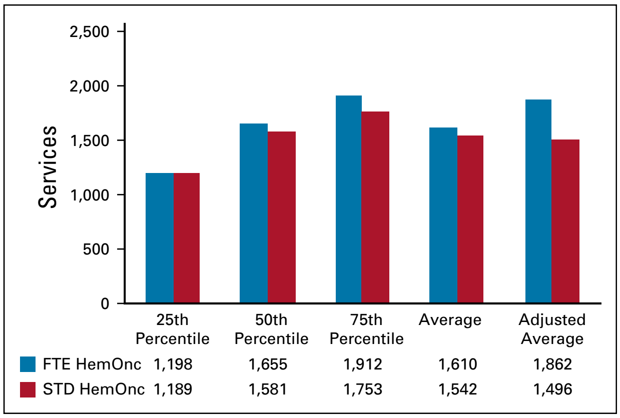


FIG A13. Initial intravenous infusion services per hematologist/oncologist (HemOnc, n = 443.2) for billing codes 96360, 96365, 96374, 96409, 96413 in 34 practices. FTE, full-time equivalent; STD, standardized.

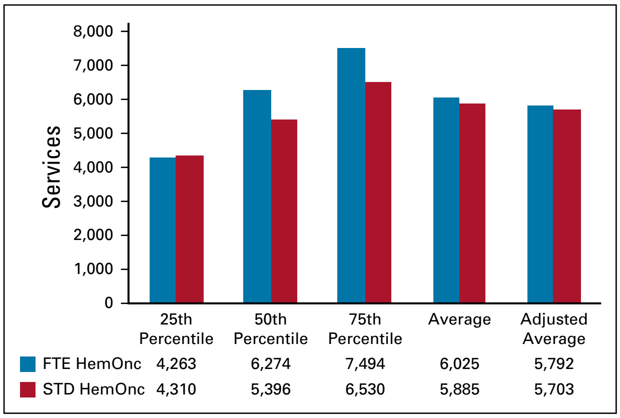


FIG A14. Drug administration services per hematologist/oncologist (HemOnc, n = 443.2) for billing codes 96360-96361, 96365-96379, 96401-96549, and G0498 in 34 practices. FTE, full-time equivalent; STD, standardized.

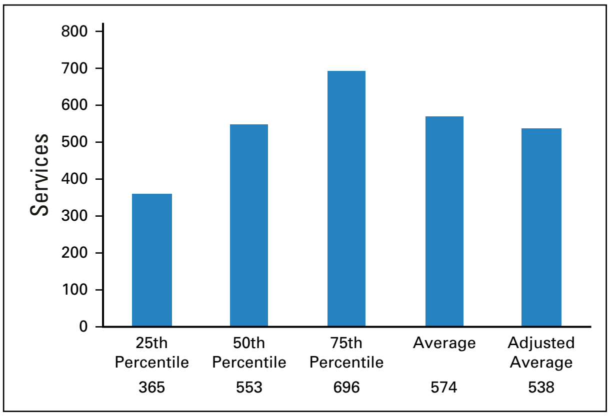


FIG A15. Initial intravenous infusion services per drug administration staff for billing codes 96360, 96365, 96374, 96409, and 96413 in 21 practices; full-time equivalent hematologist/oncologists (n = 310.5).

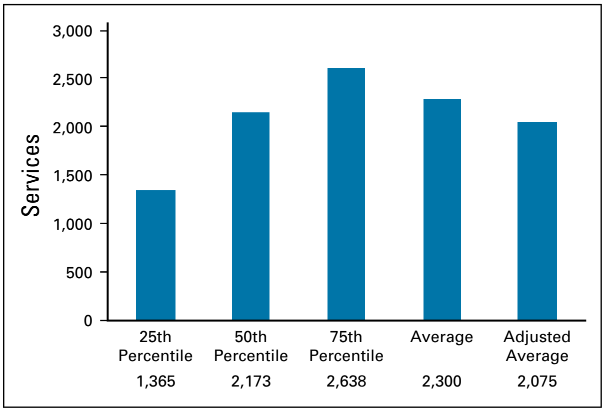


FIG A16. Drug administration services per drug administration staff for billing codes 96360-96361, 96365-96379, 96401-96549, and G0498 in 21 practices; full-time equivalent hematologist/oncologists (n = 310.5).

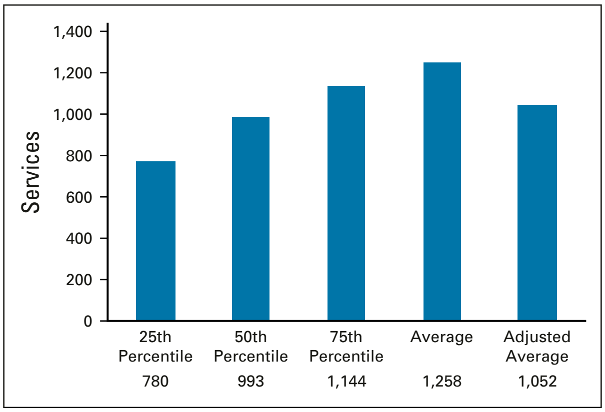


FIG A17. Drug administration services per drug administration chair for billing codes 96360-96361, 96365-96379, 96401-96549, and G0498 in 21 practices; full-time equivalent hematologist/oncologists (n = 310.5).

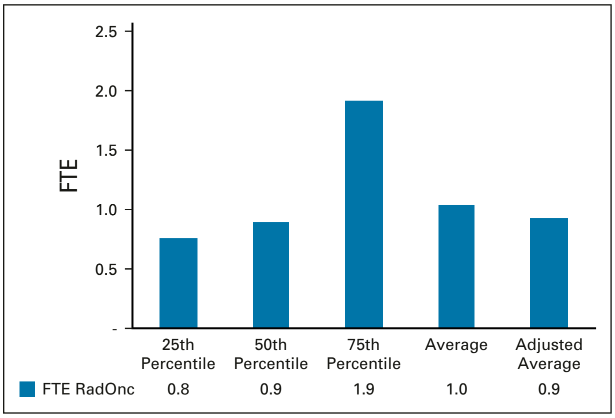


FIG A18. Radiation nurses per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 32.8) in 7 practices.

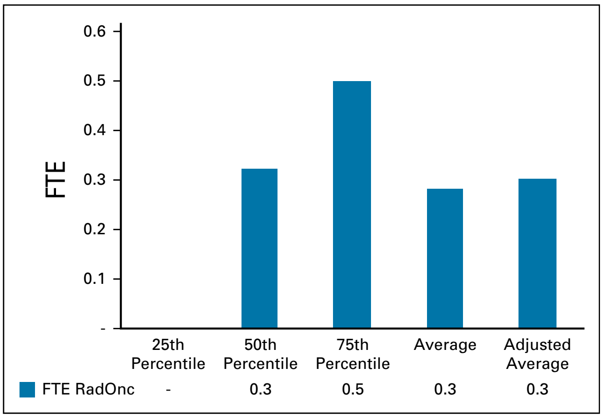


FIG A19. Radiation medical assistants per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 32.8) in 7 practices.

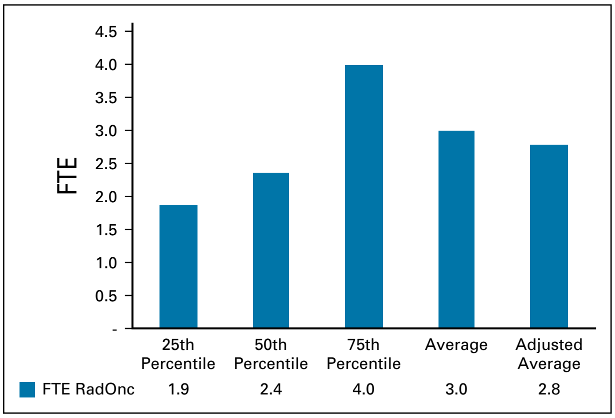


FIG A20. Radiation therapists per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 32.8) in 7 practices.

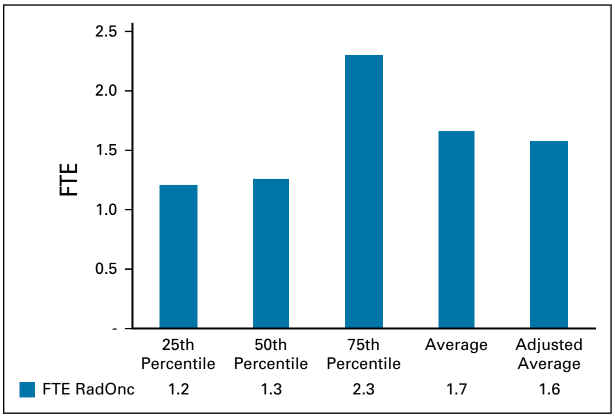


FIG A21. Physics staff per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 32.8) in 7 practices.

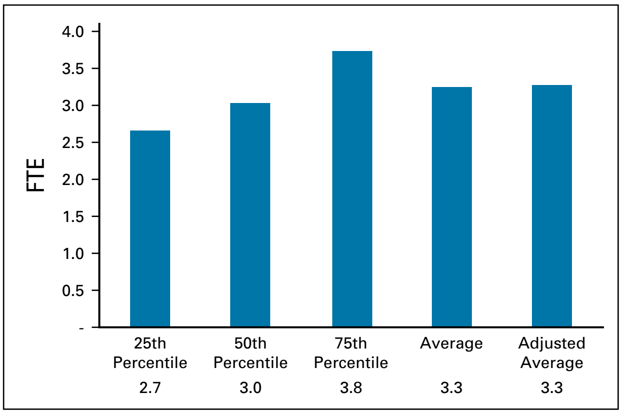


FIG A22. Radiation therapists per linear accelerator in 7 practices; full-time equivalent (FTE) radiation oncologists (n = 32.8).

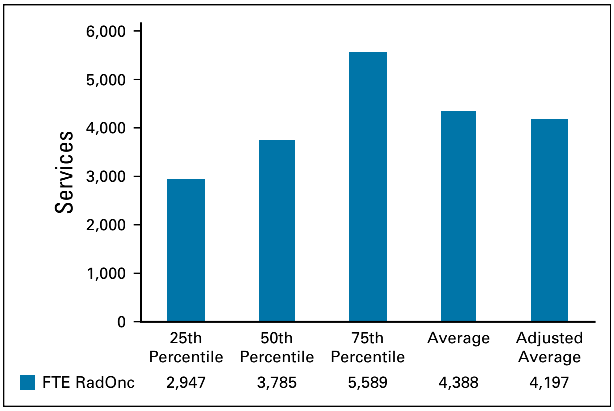


FIG A23. External beam radiation treatments per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 44.8) in 10 practices.

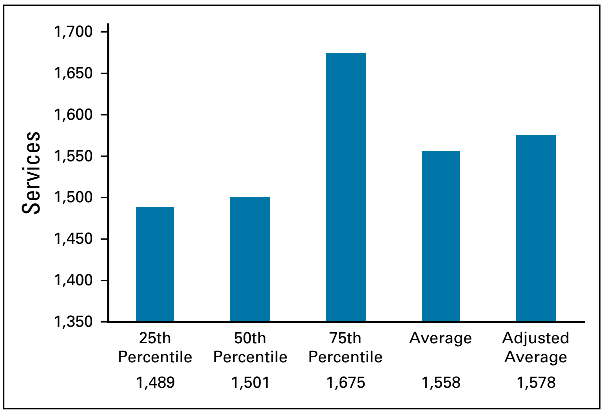


FIG A24. External beam radiation treatments per full-time equivalent FTE, full-time equivalent radiation therapist (n = 32.8) in 7 practices.

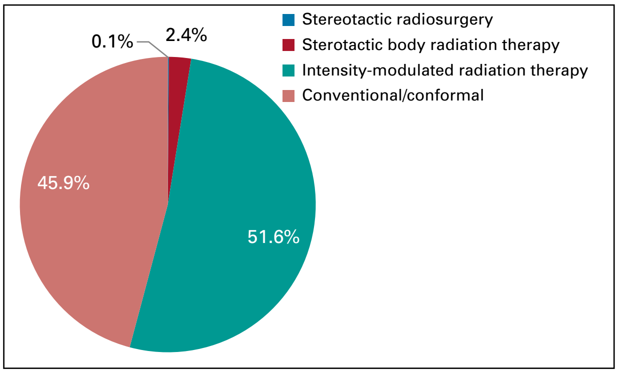


FIG A25. External beam radiation treatments by modality in 10 practices; full-time equivalent radiation oncologists (n = 44.8).

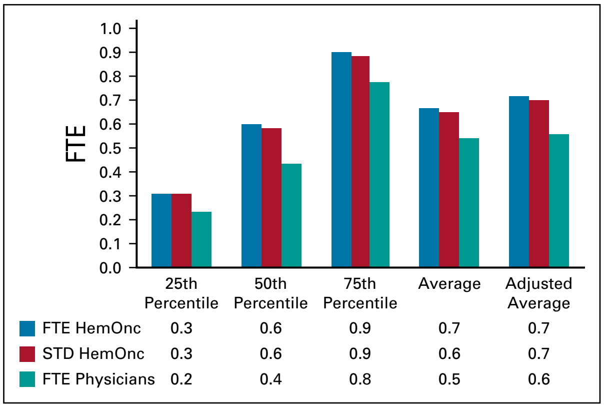
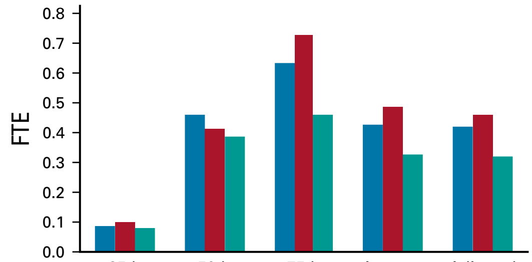
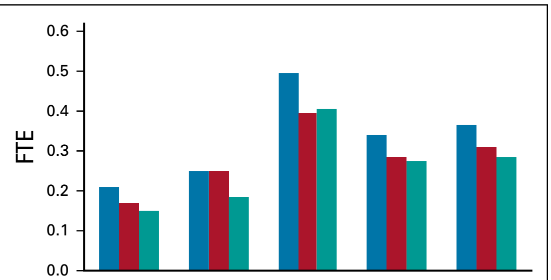


FIG A26. Clinical laboratory staff per full-time equivalent (FTE) physicians (n = 364.4) in 21 practices. HemOnc, hematologist/oncologist; STD, standardized.



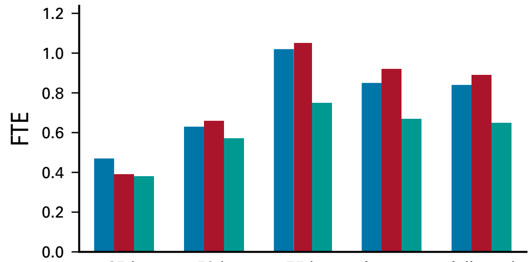
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	0.1	0.5	0.6	0.4	0.4
STD HemOnc	0.1	0.4	0.7	0.5	0.5
FTE Physicians	0.1	0.4	0.5	0.3	0.3

FIG A27. Imaging staff per full-time equivalent (FTE) physicians (n = 197.6) in 6 practices. HemOnc, hematologist/oncologist; STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	0.2	0.3	0.5	0.3	0.4
STD HemOnc	0.2	0.2	0.4	0.3	0.3
FTE Physicians	0.1	0.2	0.4	0.3	0.3

FIG A28. Point-of-care dispensing pharmacy staff per full-time equivalent (FTE) physicians, n = 197.9 in 9 practices. HemOnc, hematologist/oncologist; STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	0.5	0.6	1.0	0.8	0.8
STD HemOnc	0.4	0.7	1.0	0.9	0.9
FTE Physicians	0.4	0.6	0.8	0.7	0.6

FIG A29. Clinical research staff per full-time equivalent (FTE) physicians (n = 208.9) in 11 practices. HemOnc, hematologist/oncologist; STD, standardized.

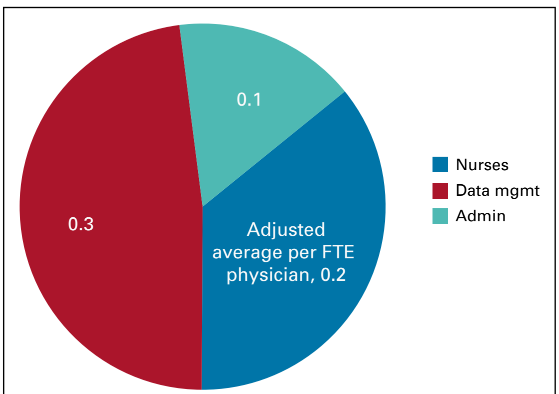


FIG A30. Classification of research staff in 11 practices; full-time equivalent (FTE) physicians (n = 208.9). Admin, administrative staff; Data Mgmt, data management.

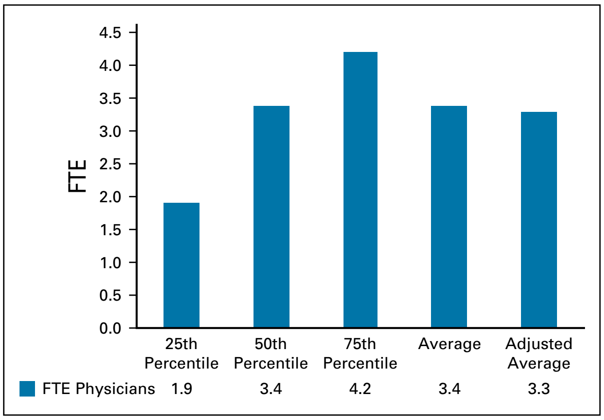


FIG A31. Total administrative staff per full-time equivalent (FTE) physicians (n = 395.4 in 25 practices.

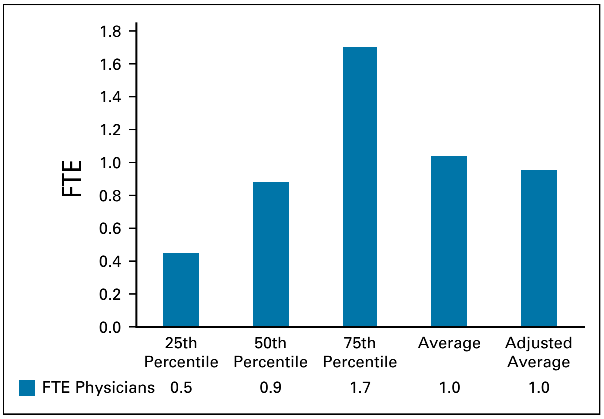


FIG A32. Front desk staff per full-time equivalent (FTE) physicians (n = 465) in 30 practices.

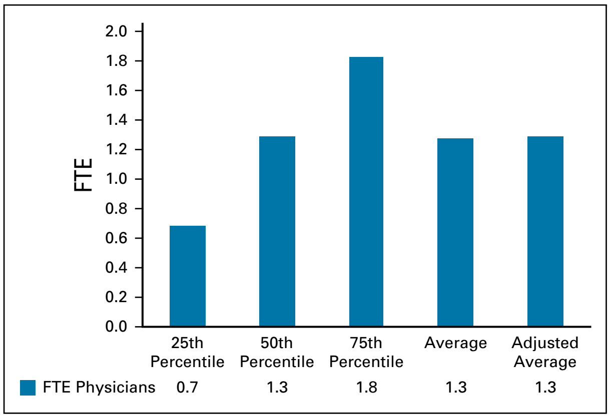


FIG A33. Billing staff (includes financial advocates and authorization), per full-time equivalent (FTE) physicians (n = 395.4) in 25 practices.

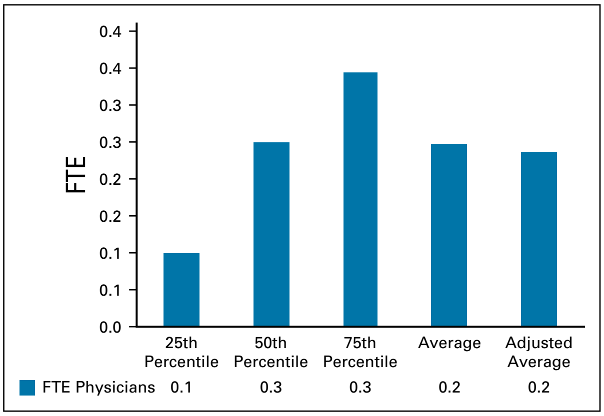


FIG A34. Financial advocates per full-time equivalent (FTE) physicians (n = 491) in 31 practices.

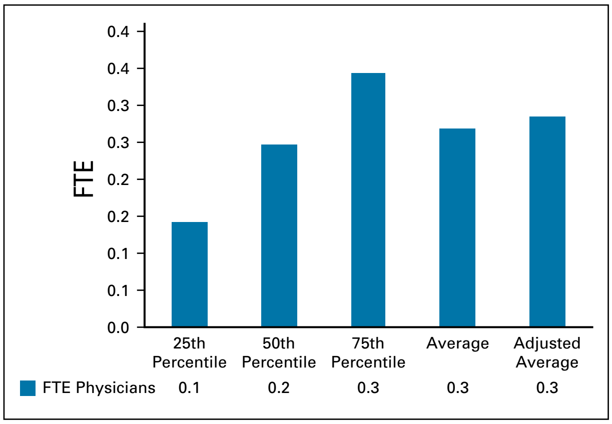


FIG A35. Authorization staff per full-time equivalent (FTE) physicians (n = 491) in 31 practices.

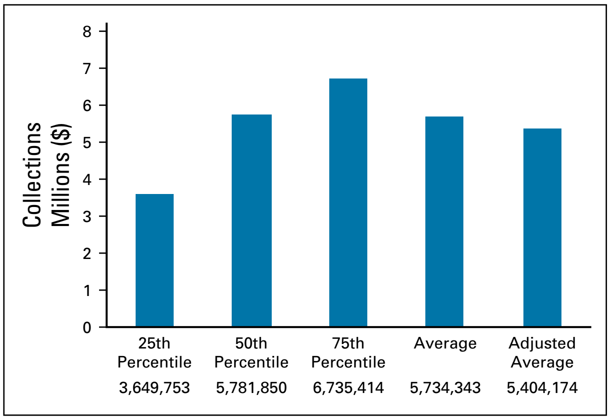


FIG A36. Annual collections per billing staff in 17 practices; full-time equivalent (FTE) physicians (n = 323.3).

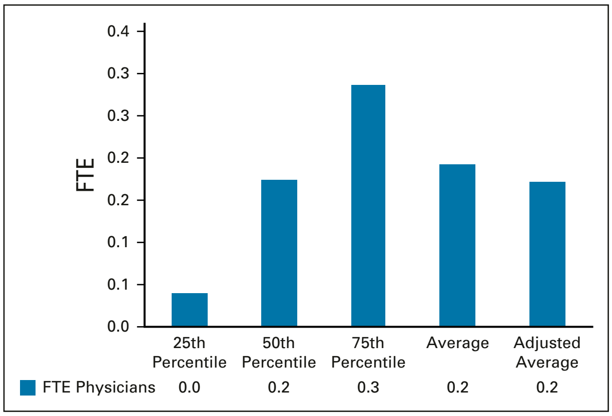


FIG A37. Executive staff per full-time equivalent (FTE) physicians (n = 482.8) in 30 practices.

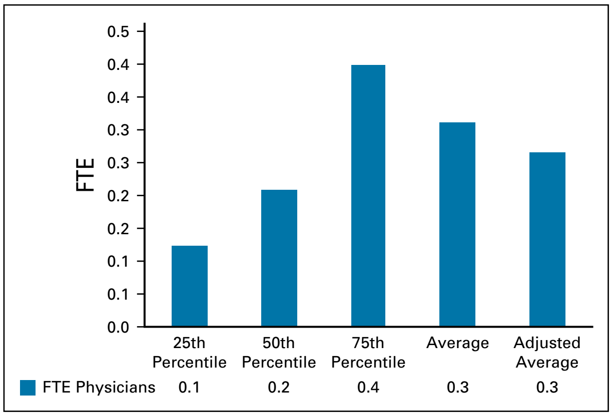
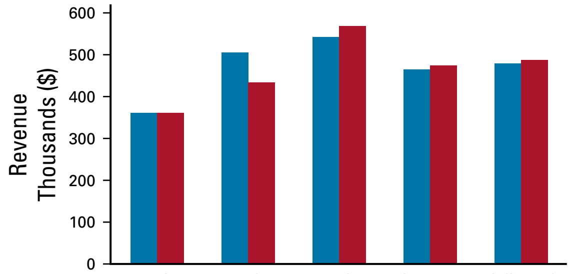
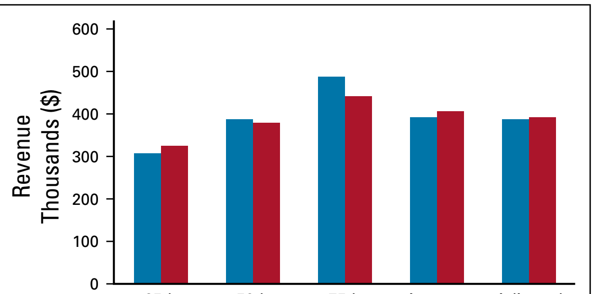


FIG A38. Other management staff per full-time equivalent (FTE) physicians (n = 482.8) in 30 practices.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	358,044	503,767	538,057	462,037	478,061
STD HemOnc	361,136	430,123	566,270	473,359	487,251

FIG A39. Hematology/oncology evaluation and management revenue per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 280.8) in 18 practices. STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	303,953	384,521	487,627	389,387	385,129
STD HemOnc	321,504	375,483	438,530	406,831	391,626

FIG A40. Drug administration revenue per; full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 275.8) in 17 practices. STD, standardized.

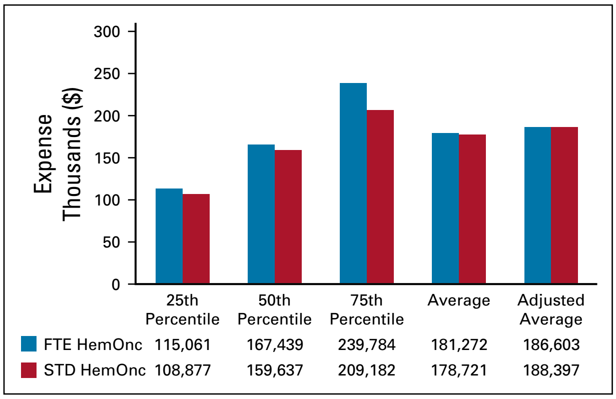


FIG A41. Drug administration staff expense per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 266.8) in 16 practices. STD, standardized.

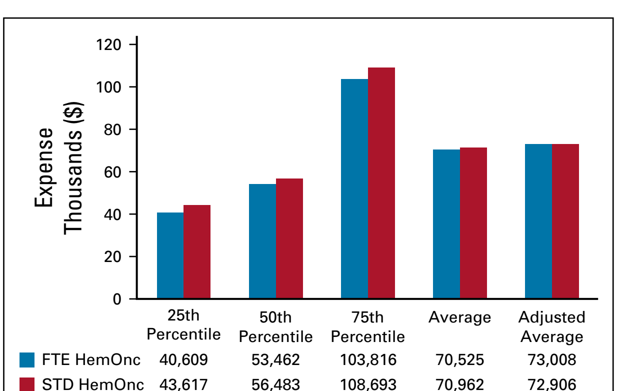


FIG A42. Drug administration supply expense per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 266.8) in 16 practices. STD, standardized.

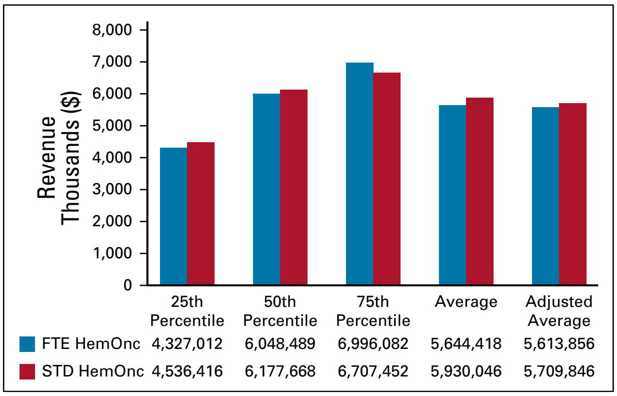


FIG A43. Drug revenue (administered) per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 275.8) in 17 practices. STD, standardized.

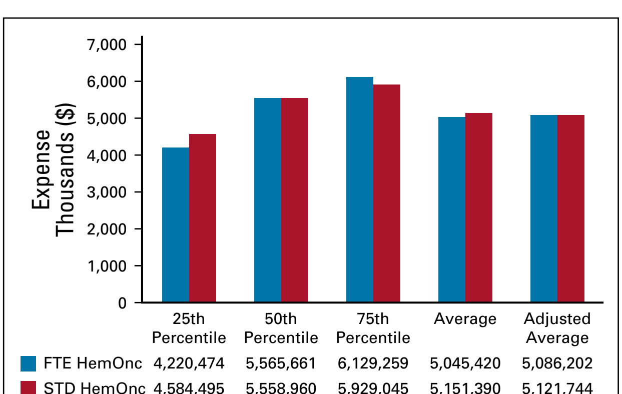


FIG A44. Drug expense (administered) per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 261.8) in 15 practices. STD, standardized.

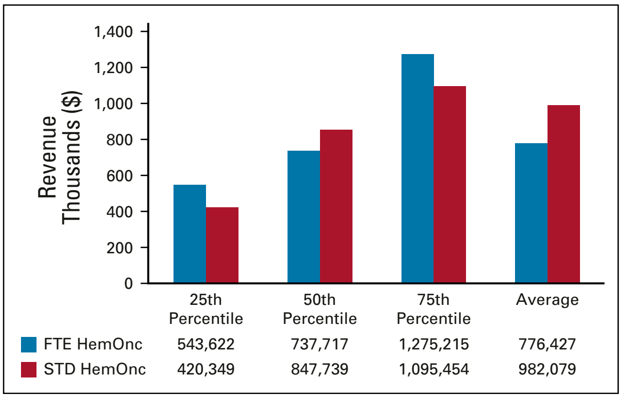


FIG A45. Drug revenue net of expense (administered) per full-time equivalent (FTE) hematologist/oncologist (HemOnc, n = 261.8) in 15 practices. STD, standardized.

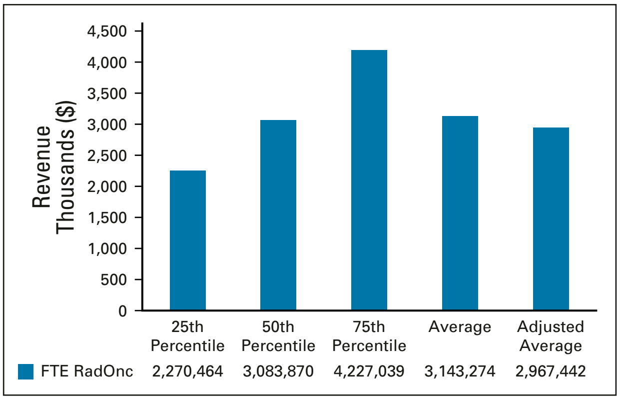


FIG A46. Radiation revenue per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 29.8) in 6 practices.

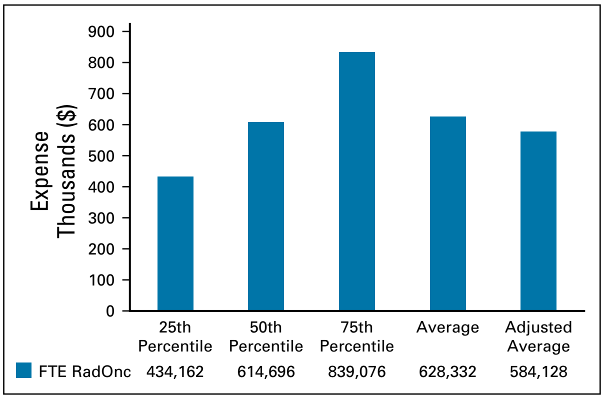


FIG A47. Radiation staff expense per full-time equivalent (FTE) radiation oncologist (RadOnc, n = 30.8) in 6 practices.

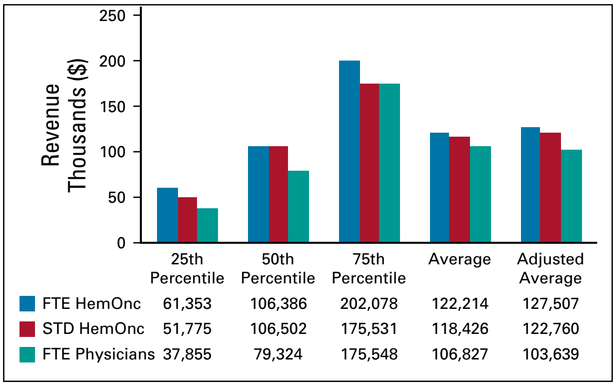
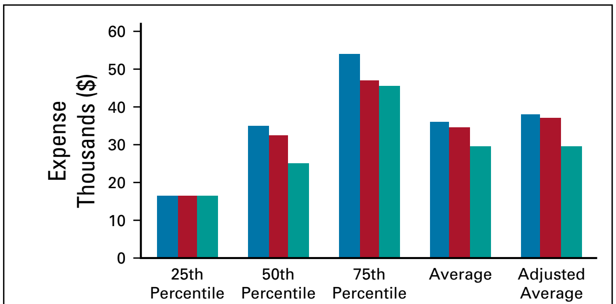
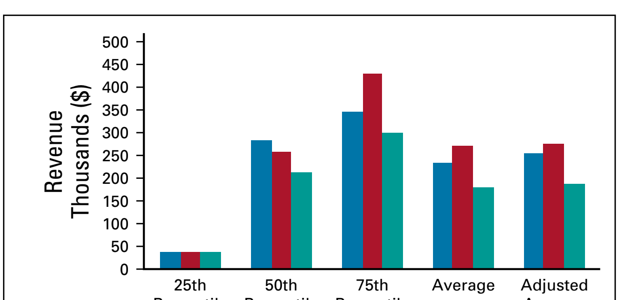


FIG A48. Clinical laboratory revenue per full-time equivalent (FTE) physicians (n = 311.1) in 15 practices. HemOnc, hematologist/oncologist; STD, standardized.



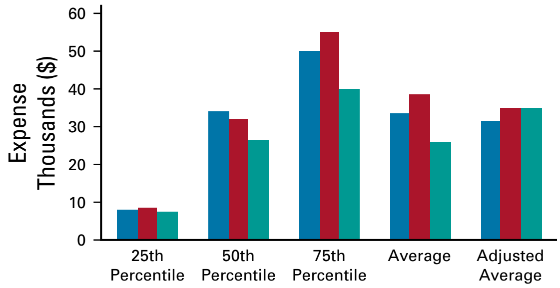
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	16,867	35,219	54,117	36,126	38,245
STD HemOnc	16,569	32,644	47,271	34,760	37,206
FTE Physicians	16,600	25,286	45,604	29,615	29,805

FIG A49. Clinical laboratory staff expense per full-time equivalent (FTE) physicians (n = 340.2) in 18 practices. HemOnc, hematologist/oncologist; STD, standardized.



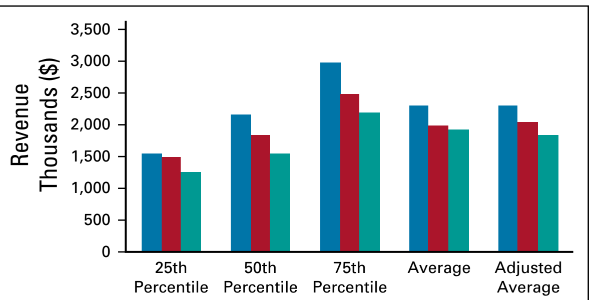
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	39,852	285,224	347,814	235,661	254,839
STD HemOnc	37,665	259,144	430,543	274,882	276,548
FTE Physicians	39,404	213,740	301,644	179,403	190,500

FIG A50. Imaging revenue per full-time equivalent (FTE) physicians (n = 269.5) in 10 practices. HemOnc, hematologist/oncologist; STD, standardized.



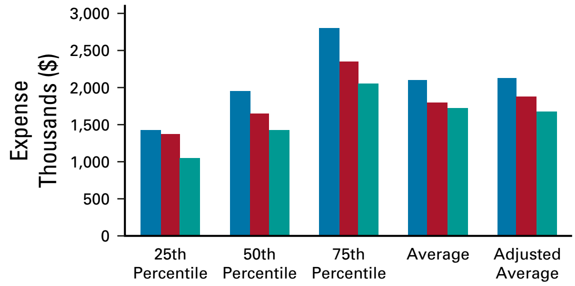
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	8,240	34,236	50,446	33,691	31,726
STD HemOnc	8,496	32,213	55,200	38,679	35,131
FTE Physicians	7,878	26,782	40,183	26,037	35,399

FIG A51. Imaging staff expense per full-time equivalent (FTE) physicians (n = 197.6) in 6 practices, HemOnc, hematologist/oncologist; STD, standardized.



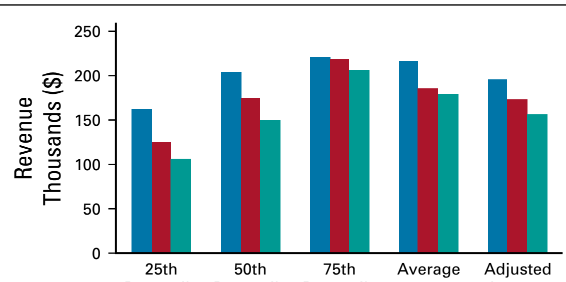
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	1,554,399	2,182,761	2,999,986	2,324,032	2,325,289
STD HemOnc	1,489,462	1,842,007	2,497,017	1,991,199	2,064,236
FTE Physicians	1,282,081	1,558,152	2,198,172	1,928,472	1,843,342

FIG A52. Point-of-care dispensing pharmacy revenue per full-time equivalent (FTE) physicians (n = 259) in 11 practices. HemOnc, hematologist/oncologist; STD, standardized.



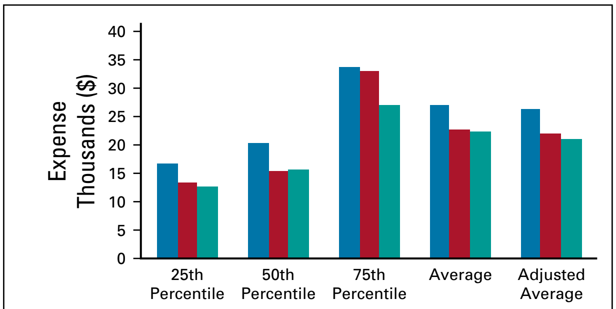
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	1,447,435	1,974,953	2,804,898	2,106,611	2,127,507
STD HemOnc	1,386,967	1,666,640	2,358,186	1,805,424	1,889,294
FTE Physicians	1,060,905	1,450,942	2,055,225	1,747,086	1,686,257

FIG A53. Point-of-care dispensing pharmacy drug expense per full-time equivalent (FTE) physicians (n = 259) in 11 practices. HemOnc, hematologist/oncologist; STD, standardized.



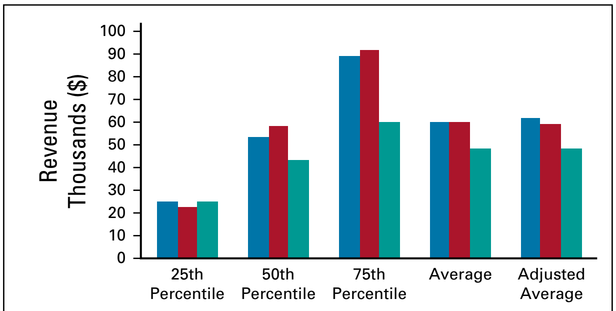
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	163,368	206,479	221,176	217,421	197,782
STD HemOnc	125,354	175,367	220,412	185,775	174,942
FTE Physicians	107,210	151,892	207,808	181,386	157,084

FIG A54. Point-of-care dispensing pharmacy drug revenue net of expense per full-time equivalent (FTE) physicians (n = 259) in 11 practices. HemOnc, hematologist/oncologist; STD, standardized.



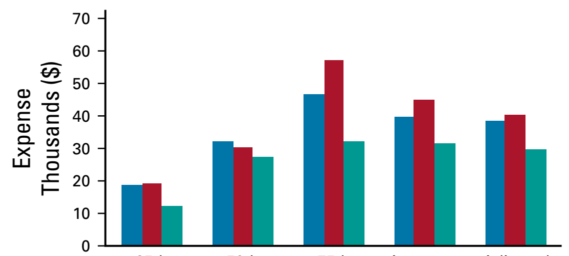
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	16,740	20,393	33,989	27,235	26,518
STD HemOnc	13,526	15,349	33,135	22,785	22,321
FTE Physicians	12,785	15,858	27,284	22,684	21,098

FIG A55. Point-of-care dispensing pharmacy staff expense per full-time equivalent (FTE) physicians (n = 202.9) in 10 practices. HemOnc, hematologist/oncologist; STD, standardized.



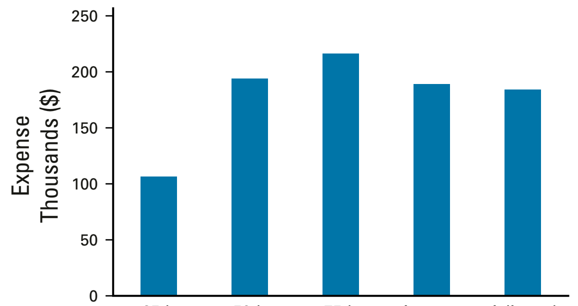
	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	25,459	53,773	89,904	60,128	62,211
STD HemOnc	23,208	58,411	92,330	60,491	59,289
FTE Physicians	25,459	43,870	60,369	48,992	49,140

FIG A56. Clinical research revenue per full-time equivalent (FTE) physicians (n = 289.8) in 15 practices. HemOnc, hematologist/oncologist; STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE HemOnc	18,943	32,499	46,855	39,803	38,612
STD HemOnc	19,574	30,568	57,638	45,392	40,798
FTE Physicians	12,320	27,726	32,322	31,696	30,103

FIG A57. Clinical research staff expense per full-time equivalent (FTE) physicians (n = 336.7) in 17 practices. HemOnc, hematologist/oncologist; STD, standardized.



	25th Percentile	50th Percentile	75th Percentile	Average	Adjusted Average
FTE Physician	107,632	194,585	217,564	189,722	185,176

FIG A58. Administrative staff expense per full-time equivalent (FTE) physicians (n = 375.4) in 23 practices.

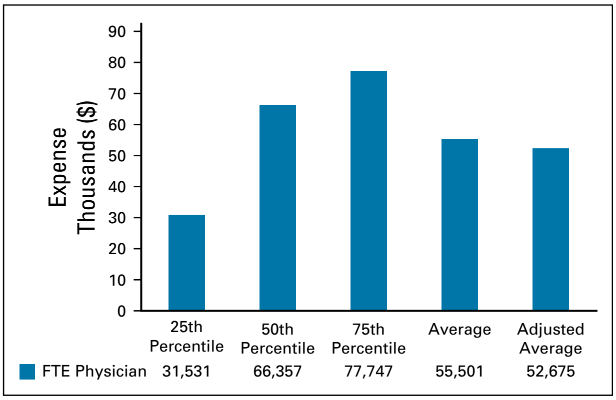


FIG A59. Information technology direct expense per full-time equivalent (FTE) physicians (n = 307.7) in 15 practices.

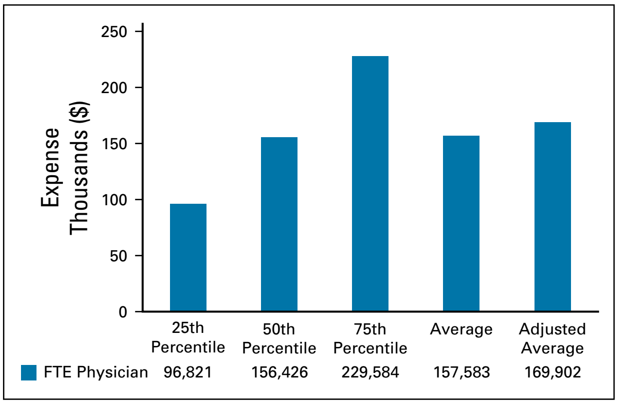


FIG A60. Facility expense per full-time equivalent (FTE) physicians (n = 367.7) in 18 practices.

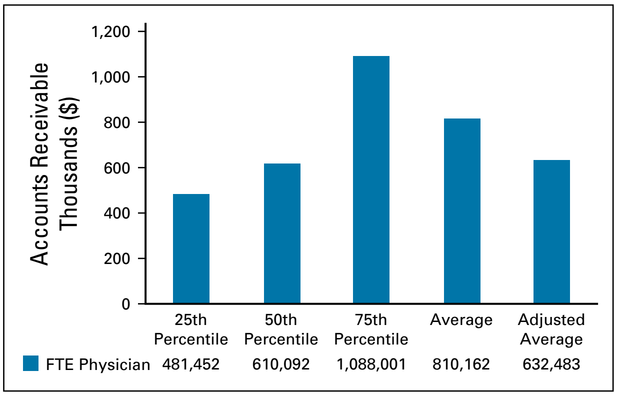


FIG A61. Year-end accounts receivable per full-time equivalent (FTE) physicians (n = 297.4) in 14 practices.

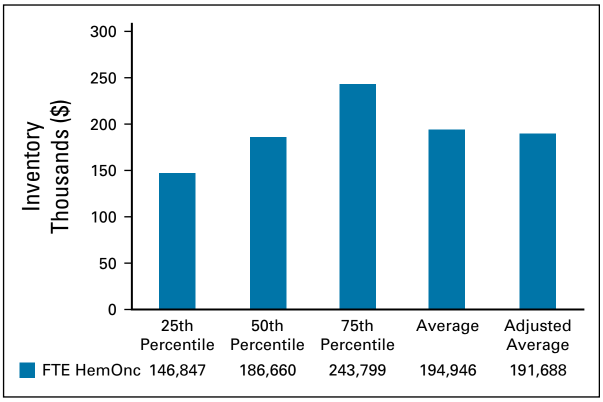


FIG A62. Year-end drug inventory (infusion) per full-time equivalent hematologist/oncologist (FTE HemOnc, n = 239.1) in 15 practices.

Attachment 9

July 26, 2023

To the Members of the North Carolina State Health Coordinating Council:

As Board-Certified Radiation Oncologists practicing at FirstHealth Moore Regional Hospital, we are writing in support of the request for an additional linear accelerator in Service Area 17 which consists of Hoke, Lee, Montgomery, Moore, Richmond, and Scotland Counties.

Linear accelerators are used to emit radiation to deliver lifesaving treatments for patients. Depending on the patient's diagnosis and treatment plan, radiation treatments are used as the sole method of treatment or in addition to other therapies, such as surgery and chemotherapy. When a patient receives a life-altering cancer diagnosis, it is crucial that our health care system have all the tools at its disposal so that treatment can begin quickly since treatment delays can impact response and effectiveness.

Currently, there are three linear accelerators in Service Area 17. Two machines are at FirstHealth Moore Regional Hospital in Pinehurst, and the third machine is at Scotland Memorial Hospital in Laurinburg.

FirstHealth Moore Regional offers state-of-the-art cancer treatments at its brand-new cancer center that opened in March 2023. FirstHealth is the tenth largest provider of radiation therapy in North Carolina, as measured by the number of ESTVs. Of the twelve largest providers of radiation therapy in North Carolina, FirstHealth is the only provider with only two linear accelerators. The other eleven providers have anywhere from three to eight linear accelerators. In fact, eight of these eleven providers perform greater than or equal to 25% ***fewer*** ESTV procedures per linear accelerator and all operate three or more linear accelerators.

The bottom line is that FirstHealth is doing much more with less, and it is putting a severe strain on our patients, staff, clinicians, and equipment. We anticipate continued growth of our practice as we have moved into a dedicated cancer center space with multidisciplinary services available for patients. When a patient is a diagnosed with cancer, the patient is supported by a team of professionals, such as medical oncologists, radiation oncologists, surgeons, technicians, nurses/navigators, and social workers. Patients who are seen by FirstHealth physicians want to stay within the FirstHealth system for radiation therapy – for example, they would not likely receive radiation therapy at a non-FirstHealth facility such as Scotland Memorial, UNC, or Duke.

Most radiation therapy is delivered on an outpatient basis with daily treatments administered over a series of weeks. This necessitates multiple trips to where the linear accelerator is located. We do not have public transportation in the Sandhills. Thus, private transportation is the norm. The patient is escorted by a family member or friend who takes them to and from their radiation therapy appointments. There is a very real cost associated with time and travel for both the patient and the patient's caregiver. Very often, the patient is in a weakened state with fatigue and nausea due to the cancer and the treatments; therefore, any travel, however brief, can be extremely challenging. While we are doing all that we can to accommodate patients as quickly as possible, patients are required to wait an average of two weeks to begin radiation therapy simply due to capacity limitations. We have implemented 10-minute appointment times as well as starting the treatment day at 6 am and running until 6:30 pm or longer. We must prioritize the health and safety of our patients and our staff. From the staff perspective, we are starting linear accelerator checks and warm up at 5 am, so we are already demanding a great deal from our staff. Starting earlier than 6am for patients or running later into the evening is also unreasonable because our patient population is older and frailer.

As outlined in the petition, FirstHealth's volume alone would demonstrate a need for an additional linear accelerator in Service Area 17. But the need methodology requires consideration of Scotland Memorial's volume, and Scotland's unit is significantly underutilized. The reason for this is that Scotland tends to treat less complex cases on its linear accelerator than we see at FirstHealth. As discussed, we cannot solve our problem by shifting patients to the Scotland linear accelerator. Scotland Memorial is about 45 minutes from FirstHealth in Pinehurst, and we have many patients who live in Montgomery and Lee counties, which is even further away from Scotland Memorial. Even if patients would be willing to shift, it is not in their best interest to do so because it would break the continuity of care and separate them from the other members of their cancer team. Cancer treatment involves a team approach to address the physical as well as emotional/mental health of the patient as they navigate their treatment. We share similar goals by implementing safety and quality, access and value to our patient population by providing radiation services to the communities we serve. Our petition is grounded in these principles, and we strongly encourage the SHCC to approve our petition for one linear accelerator in Service Area 17 in the 2024 SMFP.

We appreciate your time in considering this petition.

Sincerely,

Stephen C. King MD   Jeffrey C. Acker MD   Sushma M. Patel MD