FACTORS AFFECTING RESOURCE UTILIZATION IN THE US

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AAPM Annual Meeting 2021

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The US practice setting

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- In the US, more than 1 million radiotherapy treatment courses are delivered each year, distributed across nearly 2,500 clinics. The majority of those clinics are single-linac or two-linac facilities(1)
- More than half of all centers provide SRS services, ¾ of all centers provide VMAT, and nearly all centers provide IGRT.
- Unlike in other affluent countries with large regional healthcare facilities, specialty radiotherapy procedures such as SRS are offered in all practice settings including small community clinics.

(1) IMV Benchmark Report 2019

Process complexity

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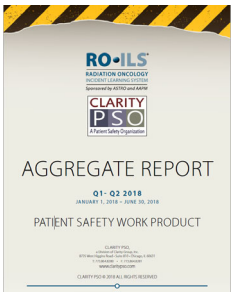
- The RO-ILS database now contains >10,000 incidents, providing invaluable insight into failure modes in the radiation oncology process
- A recent summary report highlights the complexity of modern RadOnc processes, with multiple handoff points



TG-100: IMRT process

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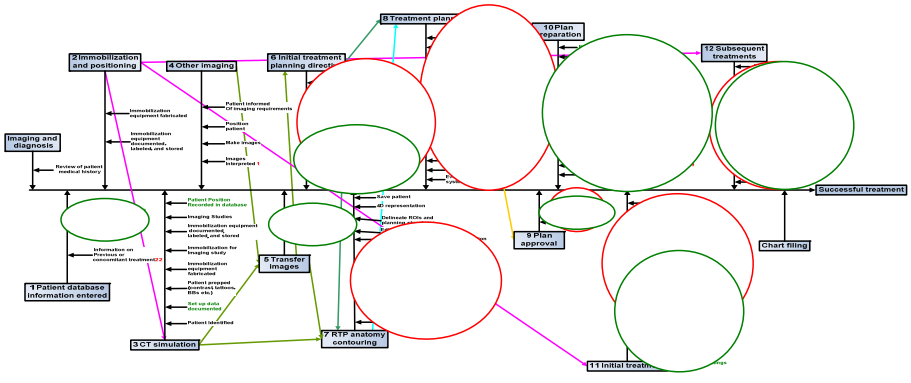
- TG-100 mapped the IMRT process for one of the authors' institutions, illustrating the complexity of modern workflows:



The Abt reports

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- Methodology tied to CPT codes and focused entirely on the physicist's median time for each CPT code
- Shows the maturity of IMRT and the shift from point-based to volume-based brachytherapy
- Do not reflect the recent community adoption of SBRT

Table 5C. Median QMP Total (Non-Procedural and Procedural) Time* (in Hours) for Surveyed Radiation Oncology Physics Services

CPT Code	Procedure Description	Abt I[†]	Abt II[†]	Abt III[†]	Abt IV[†]
77295[‡]	Therapeutic radiology simulation-aided field testing	NA	1.16	1.18	1.00
77300	Basic dosimetry calculation	0.63	0.56	0.55	0.65
77301	IMRT Treatment Planning	NA	5.53	4.53	2.85
77305[‡]	Simple isodose plan	0.82	0.54	0.69	0.87
77310[‡]	Intermediate isodose plan	0.93	0.63	0.78	0.96
77315[‡]	Complex isodose plan	1.15	0.83	0.78	1.15
77321	Special teletherapy port plan	1.21	1.06	1.07	2.63
77326	Simple brachytherapy isodose plan	2.13	1.20	2.52	3.00
77327	Intermediate brachytherapy isodose plan	2.45	1.90	2.70	3.15
77328	Complex brachytherapy isodose plan	3.87	3.18	4.78	5.00
77331[‡]	Special dosimetry	2.76	1.61	2.06	2.00
77332[‡]	Simple treatment device	0.11	0.17	0.13	0.51
77333[‡]	Intermediate treatment device	0.30	0.36	0.34	0.79
77334[‡]	Complex treatment device	0.34	0.30	0.24	0.75
77336	Continuing medical physics consultation	1.50	1.50	1.00	0.75
77338	Multileaf Collimator for IMRT	NA	NA	NA	1.04
77370	Special medical physics consultation	4.00	5.60	3.45	3.00
77785	High Intensity Brachytherapy; 1 Dwell Position	NA	NA	NA	1.60
77786	High Intensity Brachytherapy; 2 to 12 Dwell Positions	NA	NA	NA	2.00
77787	High Intensity Brachytherapy; Over 12 Dwell Positions	NA	NA	NA	3.00

* Extreme high outliers for procedural time for these codes were excluded from analysis.
† Abt I (1995), Abt II (2002), Abt III (2007), Abt IV (2014)
‡ Extreme high outliers for procedural time for these codes in 2014 were excluded from analysis.

Abt IV, 2015

ACR data

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- High-level view of actual staffing levels in accredited clinics, stratified by practice setting

H1 Hospital based; 600 or more patients
H2 Hospital based; 201-599 patients
H3 Hospital based; 200 or fewer patients
F1 Freestanding; 600 or more patients
F2 Freestanding; 201-599 patients
F3 Freestanding; 200 or fewer patients

The following table shows selected personnel ratios for each site and stratum in which the facility falls, and the corresponding data. This illustrates how the facility compares to similar accredited facilities and the summary data of all accredited facilities.

Ratio	H1	ACR Accredited Facilities
New patients (617)/FTE radiation oncologist (2.2)	272	208
New patients (617)/FTE physicist (2.875)	297	256
New patients (617)/FTE dosimetrist (2.8)	314	259
New patients (617)/FTE radiation therapist (7.8)	100	82
FTE radiation therapist (7.8)/ treatment units (2)	3.1	3.1
New patients (617)/treatment units (2)	303	226

Comment:

Ratio	H2	ACR Accredited Facilities
New patients (492)/FTE radiation oncologist (1.6)	222	208
New patients (492)/FTE physicist (2.2)	256	256
New patients (492)/FTE dosimetrist (2.95)	255	259
New patients (492)/FTE radiation therapist (6.6)	82	82
FTE radiation therapist (6.6)/ treatment units (2)	2.9	3.1
New patients (492)/treatment units (2)	225	226

Productivity?

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- Roughly 200-300 new patients annually per FTE physicist, dosimetrist and radiation oncologist in the US
- Why the seemingly low productivity, when we all feel overworked?

A different approach

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- Define a comprehensive set of treatment sites / categories
- Map the entire workflow
- Involve the full clinical team to determine the average time spent by each functional area on each process step, for each treatment site / category
- Identify factors with a strong effect on task time (e.g. software limitations, staff availability)
- Perform the evaluation in several institutions in different geographic regions

A different approach

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- Work in progress at:
  - Beth Israel Lahey Health (Boston, MA)
  - Yale Univ (New Haven, CT)
  - Northwestern (Warrenville, IL)
  - Loyola Univ (Maywood, IL)
  - Karmanos Cancer Ctr (Detroit, MI)
  - Univ Washington (Seattle, WA)

A different approach

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Treatment Categories:
External Beam - Conformal
External Beam - IMRT
External Beam - Online Adaptive
External Beam - TBI Single Fraction
External Beam - TBI Multi Fraction
Electrons - Definitive
Electrons - Boost
Electrons - Total Skin
SBRT - Lung
SBRT - Abdomen
SBRT - Pelvis
SRS/SBRT - Spine
Cranial SRS - Linac Single Target
Cranial SRS - Linac Multi Target
Cranial SRS - GammaKnife
LDR Brachy - Prostate Seed
IORT
HDR Brachy - GYN - Vag Cylinder
HDR Brachy - GYN - T&R/T&O
HDR Brachy - GYN - Interstitial
HDR Brachy - Prostate
HDR Brachy - Bronchial/Esophageal/Hepatobiliary
HDR Brachy - Skin flap
HDR Brachy - Skin - Solid Applicator

	Common process sub-steps
1	**Referral and Consultation**
	Receive referral and schedule consultation
	Obtain medical records relevant for consultation
	Review of medical history prior to consultation
	Consultation with patient
	Documentation of consultation and recommendations
2	**Simulation**
	MD order for simulation
	Review simulation order and prepare for simulation
	Simulation procedure
	Documentation of simulation
	MD directives for treatment planning
3	**Treatment Planning**
	Review medical record (MD directives, simulation notes)
	Import data sets needed for planning
	Image registration
	Contouring (targets, OARs etc)
	Dosimetric treatment planning (technique, optimization)
	MD review/approval of plan(s)
	Complete plan checklist, documentation, data export
4	**Pre-Treatment QA**
	Physicist review - plan vs MD intent
	Physicist review - technical
	Physicist review - other
	Dry run / measurement based QA
	Therapist review and setup instructions
5	**Treatment Delivery and Management**
	Prepare treatment room for patient
	Treatment delivery session (per fraction)
	Treatment delivery documentation
	On-treatment patient management
	Treatment completion and follow-up plan

A different approach

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Snapshot from SBRT Abdomen category for one institution

	NUMBER OF TREATMENT FRACTIONS:		TREATMENT CATEGORY:	SBRT - Abdomen							
	5		Date of analysis:	(Date or date range)							
			TOTAL AVG PROCEDURAL TIME (min):	2317							
					Average sub-step time (min)						
Step Num	Process Map Step Name	Sub-Step Num	Relevant technologies/systems	Process issues/limitations	MD	RN	RTT	Dosim	Phys	Supp Staff	Total time for for sub-step (min)
2	**Simulation**	2.0		Step Time Totals	60	45	120	0	20	15	260
	MD order for simulation	2.1	EPIC, ARIA	Scheduling sim	20					15	35
	Review simulation order and prepare for simulation	2.2	EPIC, ARIA, RPM?	Clarifications (email threads RTT to MD)	15	20	25				60
	Simulation procedure	2.3	EPIC, ARIA, RPM?	Motion management decision tree - Inhale BH, Exhale BH, Gated	15	25	80		20		120
	Documentation of simulation	2.4	ARIA	Time spent to schedule patient for # of treatments	3		40				38
	MD directives for treatment planning	2.5	ARIA		7						7
3	**Treatment Planning**	3.0		Step Time Totals	95	0	0	700	35	0	830
	Review medical record (MD directives, simulation notes)	3.1	ARIA					15			15
	Import data sets needed for planning	3.2	ARIA, Philips PACS	Ambiguity in MD directives re. imaging studies to register				30			30
	Image registration	3.3	Eclipse	Multiple imaging studies to rgister	5			35	5		45
	Contouring (targets, OARs etc)	3.4	Eclipse	Delays in MD contouring of GTV/CTV; lack of consistency between MDs in PTV generation/review	60			220	10		290
	Dosimetric treatment planning (technique, optimization)	3.5	Eclipse, templates	Liver: iterative process to optimize Veff&NTCP				300	20		320
	MD review/approval of plan(s)	3.6		Frequent delays in MD review of plans, off-site communication delays	30			10			40
	Complete plan checklist, documentation, data export	3.7	Eclipse, Excel summary tables	Manual data transfer for dose summaries				90			90

Preliminary results

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- Significant variation in resource use between institutions
- Most significant factor appears to be physician conventions and availability, not technology
- Automation tools appear to be the second-most impactful factor, reducing process time in institutions that have deployed a high level of automation

Opportunities

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- The CMS Alternative Payment Model may create an incentive for physicians to change practice conventions with a focus on process efficiency
- Standardization can lead to better efficiency, but only if the physicians are supportive
- Automation (when appropriate) can improve efficiency, but requires capital investment (or higher operating cost)