

OEI Oncology days 2025

Towards the agreement of minimum treatment volumes

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Topics

- **Volume – outcome association in radiotherapy (RT)**
 - Results of Systematic Review
- **Quality indicators in RT**
 - Structural
 - Process
- **Collective quality assurance in RT**
- **Minimum treatment volumes in RT guidelines and accreditation**

Volume – outcome association in RT

Systematic Review and Meta-analysis (Kyaw 2023)

Aim: to assess a potential association between radiation therapy volume and patient outcomes.

- Inclusion of n=20 studies
- head and neck cancers (HNCs): n=7
- cervical cancer: n=4
- prostate cancer n=4
- High-volume radiation therapy faculties are associated with a lower chance of death compared with low-volume radiation therapy faculties
 - Pooled Hazard Ratio 0.90 (95% CI 0.87 – 0.94)

Volume – outcome association in RT

- Evidence of a volume – outcome association in:
 - Head and neck cancer
 - Prostate cancer
 - Cervical cancer

Study or Subgroup	log[Hazard Ratio]	SE	Weight	Hazard Ratio IV, Random, 95% CI	Hazard Ratio IV, Random, 95% CI
1.1.1 Nasopharyngeal Head and Neck					
Ha et al (2019)	-0.84397	0.150747	1.6%	0.43 [0.32, 0.58]	
Lai et al (2020)	-0.16252	0.045892	5.2%	0.85 [0.78, 0.93]	
Verma et al (2018)	-0.16252	0.063859	4.2%	0.85 [0.75, 0.96]	
Yoshida et al (2018)l	-0.23572	0.069052	4.0%	0.79 [0.69, 0.90]	
Subtotal (95% CI)			15.0%	0.74 [0.62, 0.89]	
Heterogeneity: Tau ² = 0.03; Chi ² = 19.45, df = 3 (P = 0.0002); I ² = 85%					
Test for overall effect: Z = 3.28 (P = 0.001)					
1.1.2 Non-Nasopharyngeal Head and Neck					
Chen et al (2010)	-0.23902	0.068702	4.0%	0.79 [0.69, 0.90]	
David et al (2017)	-0.22565	0.029614	6.0%	0.80 [0.75, 0.85]	
Subtotal (95% CI)			10.0%	0.80 [0.75, 0.84]	
Heterogeneity: Tau ² = 0.00; Chi ² = 0.03, df = 1 (P = 0.86); I ² = 0%					
Test for overall effect: Z = 8.37 (P < 0.00001)					

Strongest evidence in head and neck cancer

Volume – outcome association in RT

Discussion

- Multifactorial reasons for improved outcome in high-volume radiation therapy faculties
 - Better experience in dealing with complex cases
 - Greater expertise in complex techniques
 - Larger radiation therapy workforce capacity
 - But: equitable access to services needs to be considered
- Limitations
 - Heterogeneity in cohort selection and volume definitions / categorizations
 - Limited generalizability (most studies conducted in the United States)

Volume – outcome association in RT

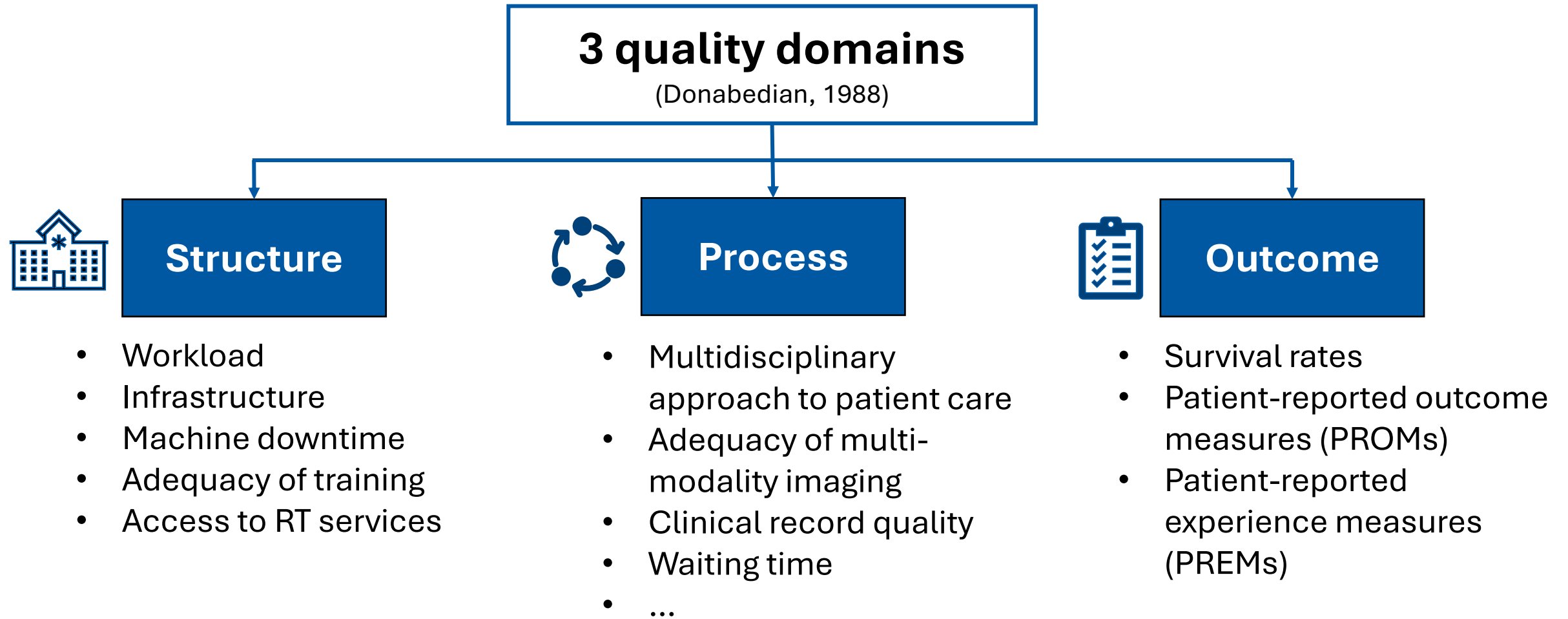
Discussion

- Difficulty in determining optimum volume threshold
 - Example for nasopharyngeal studies:

Study	Threshold	Definition of high volume faculty
Ha et al, 2019 (South Korea)	10 cases min. annual faculty volume over study period (24 years)	≥ 10 cases per year
Lai et al, 2020 (Taiwan)	1 st quartile total volume over study period (17 years)	≥ 86 cases over study period
Verma et al, 2018 (USA)	80 th percentile total volume over study period (10 years)	≥ 11 cases over study period
Yoshida et al, 2018 (USA)	95 th percentile min. annual faculty volume over study period (11 years)	≥ 3.36 cases per year

Difficulty in quantification of experience in radiotherapy

Quality indicators in RT



Quality indicators in RT: Structure



Structure

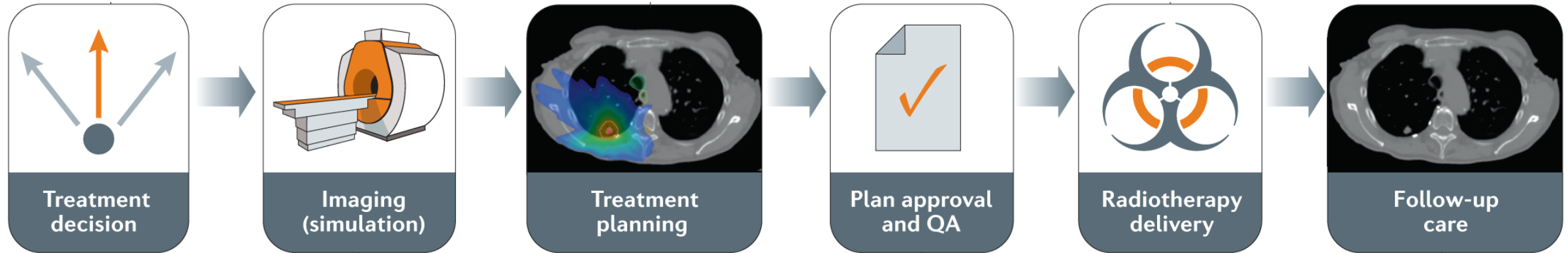
- Workload
- Infrastructure
- Machine downtime
- Adequacy of training
- Access to RT services

$$\textit{Workload} = \frac{\textit{Total number of patients treated in 1 year}}{\textit{Number of workers}}$$

- Radiooncologists
- Medical physicists
- Radiotherapy technologists

Quality indicators in RT: Process

Multistep and peer-group process



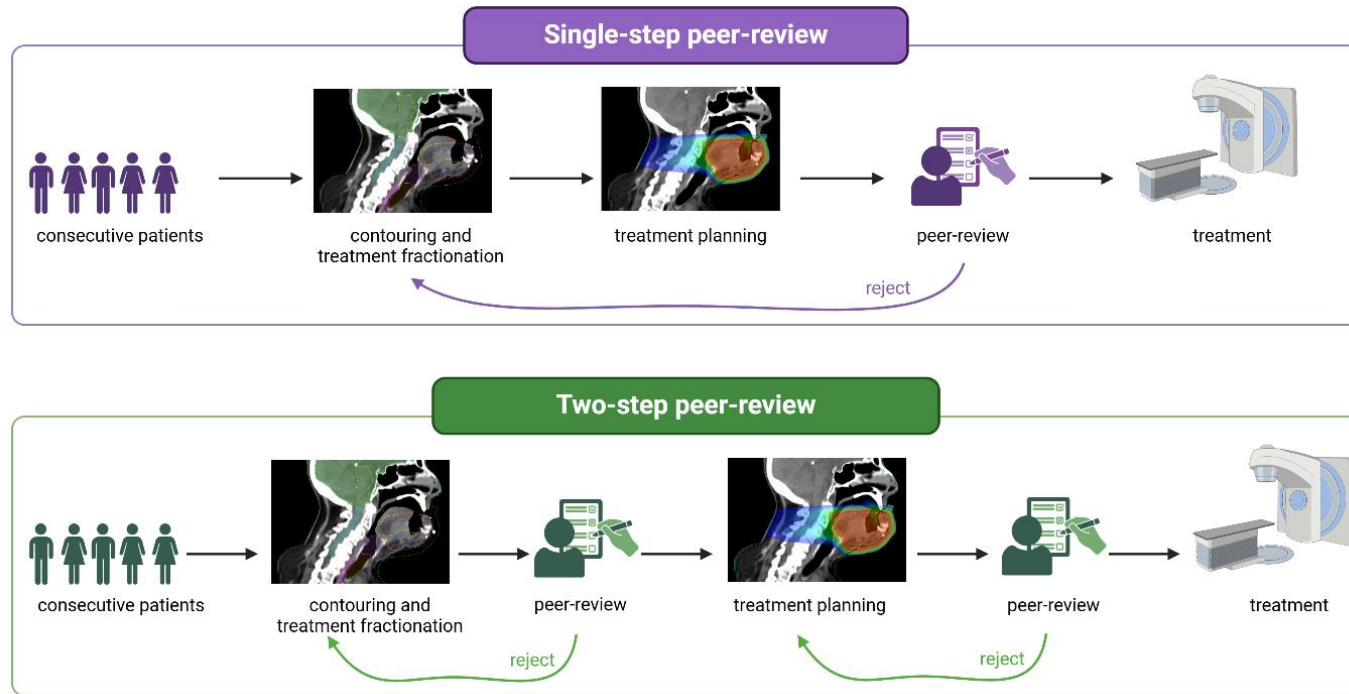
- Almost completely digitalized
- Dedicated infrastructure
- AI supported

- Radiation oncologists
- Medical physicist
- Dosimetrist
- Therapist
- Administrative staff

Quantification of experience in RT: Process & multidisciplinary team

Quality indicators in RT: Process

A prospective cohort study to evaluate peer-review in radiation oncology



Two-step peer-review

- **Better treatment quality**

- ↑ Contour and fractionation changes

- 16% vs. 5% ($p < 0.001$)

- Dose distribution changes

- 1.1% vs 1.9% ($p = 0.15$)

- **Participant preference**

- ↑ Teaching opportunities

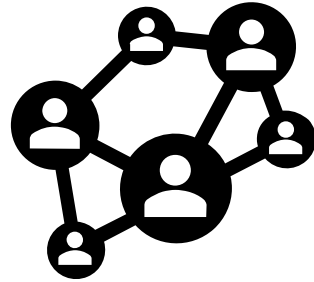
- ↑ Consistency in the department

- ↑ Sense of security

Median 16.5 participants at peer-review rounds

Quality assurance in Radiotherapy

RT



Collective experience

Multi-step procedure with review rounds

- Low entry threshold for trainees
 - Fast learning due to ↑ teaching opportunities
- Robustness against individual errors

Surgery



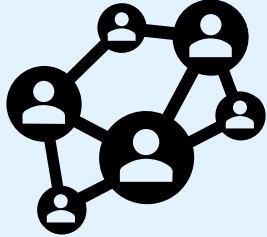

Individual experience

Single-step live performance

- High entry threshold for trainees
 - Vulnerability to individual errors
- Surgeon-based treatment volumes

RT: Center-based definition of treatment volume

Quality assurance

Radiotherapy	v/s	Surgery
 <p>Collective</p>	Experience	 <p>Individual</p>
Multi-step & review rounds	Procedure	Single-step live performance
Low ↑ teaching opportunities	Entry threshold for trainees	High
Low	Vulnerability to individual errors	High
Center-based	Definition of minimum treatment volumes	Surgeon-based

Treatment Volume in Radiotherapy guidelines

ESTRO guidelines

- No recommendations for minimal treatment volume so far
- Recommendations for centralized RT treatment, emphasized in rare / pediatric cancer

NCCN guidelines

- No recommendations for minimal treatment volume so far
- Recommendation for RT treatment in experienced / high-volume centers
 - For several cancer entities
 - Most emphasized for SBRT and RT in tumor recurrence

Treatment planning in multidisciplinary teams and experienced centers

Treatment Volume in RT Center Accreditation

German Cancer Society – Deutsche Krebsgesellschaft DKG

Catalogue of Requirements for Radio-oncology

Centre	Number of radiotherapy treatments per year and centre
Oncology Centres	≥ 800 patients (≥ 200 patients in the Oncology Centre) Clinical site of a network with 1 accelerator ≥ 400 patients (≥ 100 patients in the Oncology Centre)
Anal Cancer	≥ 6 patients
Head and Neck	≥ 30 patients
Paediatric Cancer	Number must be recorded
Lung Cancer	Primary treatment: ≥ 50 patients (≥ 5 patients extracranial SBRT) Total number: ≥ 100 patients
Prostate Cancer	≥ 50 patients (for 25-49 cases: at least 75 patients in the 5 years prior to the audit)
Soft Tissue Sarcoma	≥ 20 patients

Minimum treatment volumes for oncology / cancer centers

Treatment Volume in RT Center Accreditation

German Cancer Society – Deutsche Krebsgesellschaft DKG

Catalogue of Requirements for Radio-oncology

Lung cancer: Technique	≥ 20 extra- and intracranial SBRT of any indication/year	
Brachytherapy	≥ 100 therapies within the last 5 years	
Systemic Tumour Therapy by Radio-oncology	≥ 50 systemic tumour therapies in combination with radiotherapy for solid tumours (unless specified below)	
	Lung cancer	≥ 30 patients
	Head and Neck cancer	≥ 15 patients
	Soft Tissue Sarcoma	≥ 30 patients

Minimum treatment volumes for treatment methods

Treatment Volume in RT Center Accreditation

Organisation of European Cancer Institutes OECI

Accreditation and Designation – Quantitative Questionnaire for Radiotherapy Treatment

- Information on **department certification** (standard of certification, international/national)
- Data related to the radiotherapy department – use of treatment machines
 - **Hours of operation** of linear accelerators per week
 - Total **number of radiotherapy treatment courses** per year – **no organ-specific numbers**
 - Number of IMRT/VMAT treatment courses per year
 - Number of stereotactic treatment courses per year – **no specific number for lung cancer**
 - Number IGRT treatment courses per year
 - Number of CT/MR based brachytherapy procedures per year
 - *Lacking: Number of radio-chemotherapy courses per year*

Declaration of specific treatment courses per year

Towards the agreement ...

... of minimal treatment volumes in Radiotherapy

- Evidence for volume – outcome association in Radiotherapy
 - Heterogeneous volume thresholds in literature
- Multistep and peer-group approach
 - Requirement for center-based numbers
- Current definition of minimal treatment volumes
 - For Radiotherapy center accreditation (DKG)
 - Not yet in Radiotherapy guidelines (ESTRO and NCCN)