

Rapid automated extraction of dose-volume histogram data for arbitrary patient cohorts

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Introduction

- Retrospective DVH analysis can aid in comparing treatment techniques and can inform clinical practice.
- We developed a user-friendly software tool that can be used to quickly & easily extract DVH data from the Varian Eclipse treatment planning system for any patient cohort.
- We used this tool to analyze various cohorts of interest in our centre, two of which are described here.

The Software

- Developed in C# using ESAPI.
- Executed outside of Eclipse with read-only access to data.
- Data are retrieved one patient at a time, at a rate of a few seconds per patient.

Schematic overview of the software



Example DVH queries

	A	B	C
1	Structures	Criteria	Requested units
2	PTV	Dmax	Gy
3	Rectum	V60Gy	cc
4	Bladder	D1cc	%

Robust handling of structure names

	A	B	C	D
1	Structure	Synonyms		
2	PTV	PTV 60	PTVp	PTV 60/20
3	Lung Bilateral	Lung B	Lung_B	

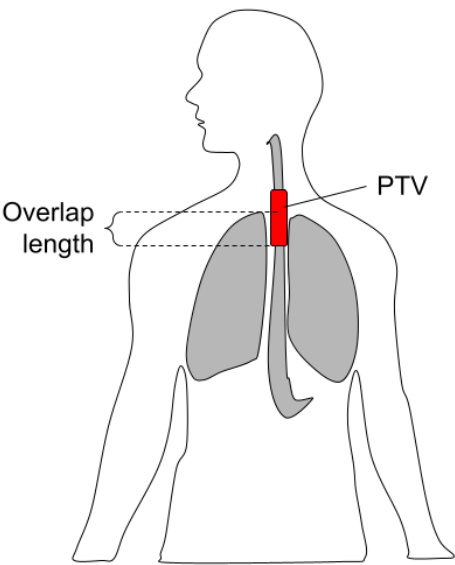
Queryable information:

- VolumeAtDose
- DoseAtVolume
- D_{max}
- D_{min}
- D_{mean}
- Absolute volume
- Overlap between structures

Case Study: Esophagus Cancer Patients

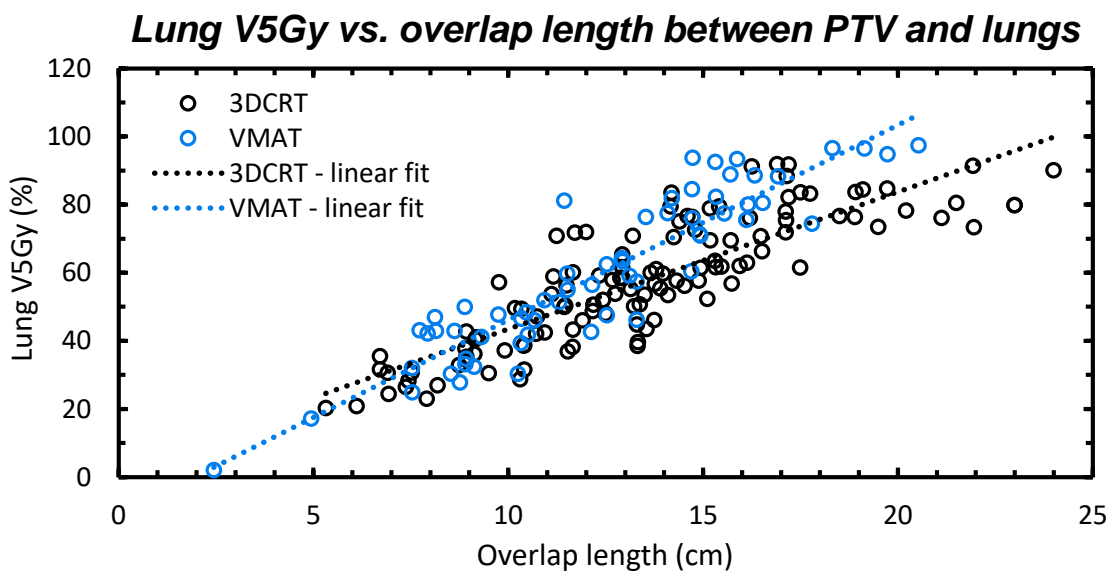
Motivating questions:

- Is there a difference in low dose to the lungs for VMAT vs. 3D conformal planning technique?
- Does this difference vary with the amount of overlap between the target and the lungs (overlap length)?



Cohort:

- Esophagus cancer patients treated with 50 Gy / 25 fractions.
- N = 182 pts (Dec. 2011 – Dec. 2022)
- 67% treated with a 3D conformal technique.
- 33% treated with a VMAT technique.



Discussion:

- V5Gy is ~10-20% higher for VMAT vs. 3D conformal if overlap length ≥ 15 cm.
- Similar trend for Lung V10Gy.
- Similar trend for patients treated with 41.4 Gy / 23 fractions (N=59).
- Overlap length is informative when determining planning technique.

Case Study: Breast Cancer Patients

Motivating question:

- How do heart and lung doses compare for patients treated with a tangent pair using a deep-inspiration breath hold (DIBH) technique vs. a free breathing (FB) technique?

Cohort:

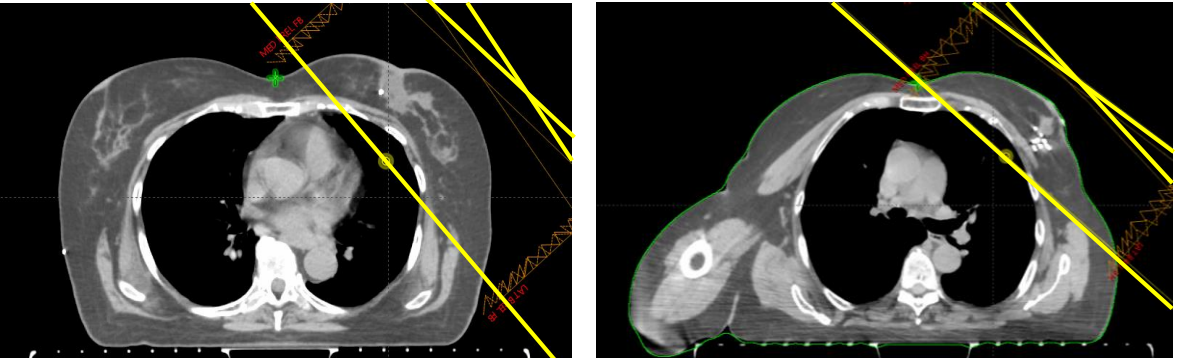
- Breast cancer patients treated with 42.5 Gy / 16 fractions
- N = 1608 pts (Feb. 2014 – Dec. 2022)

Laterality	Technique	N	Heart D _{mean} (cGy)	Heart D _{max} (cGy)	Lung V16Gy (%)
Left	FB	296	87 ± 1	1950 ± 70	8.8 ± 0.3
Left	DIBH	519	82 ± 1	1170 ± 4	10.1 ± 0.2
Right	FB	793	33 ± 1	1150 ± 2	11.5 ± 0.2

Discussion:

- For patients with left-sided breast cancer, treatment with DIBH generally results in lower heart D_{max} and higher lung V16Gy compared to FB.
- Tendency to compromise breast coverage to satisfy heart dose constraint for patients treated with FB technique. (strive for D_{mean} < 100 cGy, accept < 200 cGy)

Representative examples of FB vs. DIBH breast coverage



Patient treated with FB

Patient treated with DIBH

In future work we aim to retrospectively quantify the extent of improved breast coverage associated with DIBH by using Limbus AI to auto-contour breast tissue for a subset of cases.