
DVH Analytics: An Open-Source DICOM-RT Database

60th Annual Meeting of the AAPM in Nashville, TN

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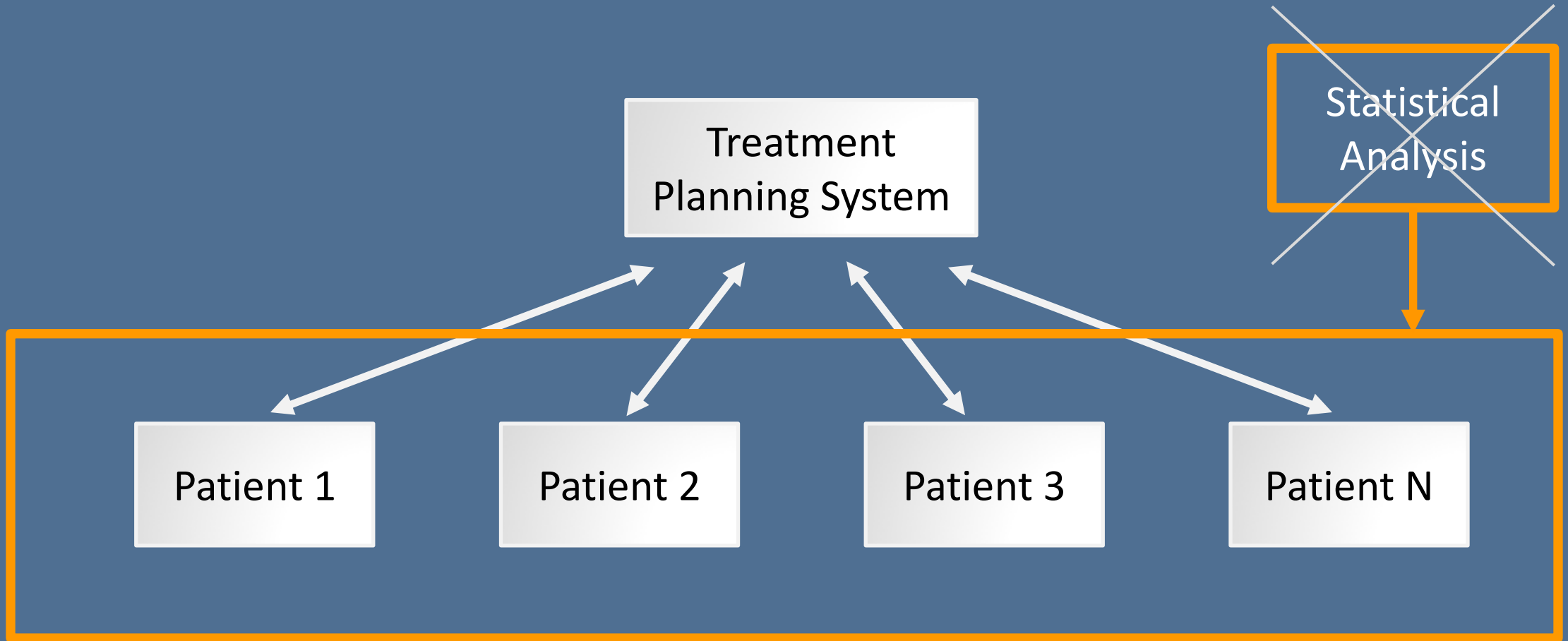
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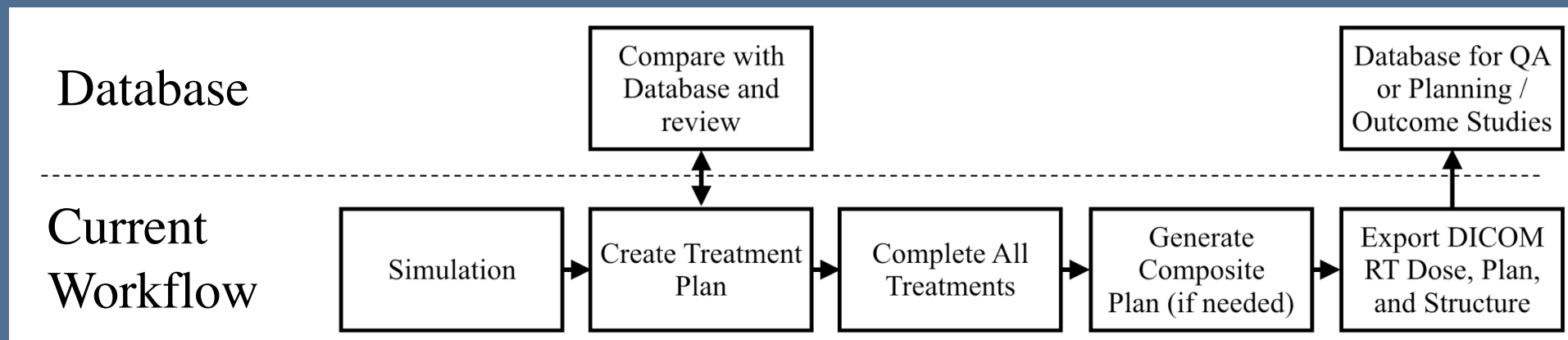
⁴Northwestern Chicago Proton Center

Introduction



Introduction

- What is the highest dose we've ever given to the spinal cord?
- How much lower are heart doses for breast treatments in the prone position?
- Is VMAT dosimetrically superior to Step-N-Shoot?
- Why does the plan I'm checking have an OAR exceeding a DVH constraint?
- Can I reasonably get a better DVH?
- What OAR dose does this physician typically accept?



Challenges & Limitations

Challenges

- Database integrity
 - No duplicate data
 - Boosts? Re-plans?
- Contour name variation
- Data transcription errors
- Connecting patient data not stored in DICOM files
 - Toxicities
 - Surgical status
 - Chemo

Limitations

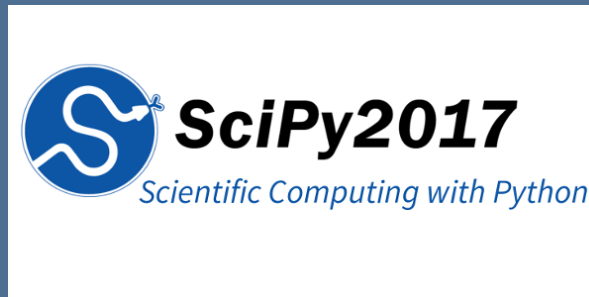
- Using data without context can be counter-productive
- Contour delineation
 - Anatomical or Planning?
 - Partial delineations
 - Expertise of planner/resident/physician
- Planning data only
 - can't account for delivery or patient set-up errors



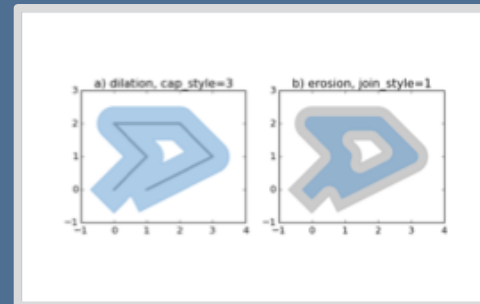
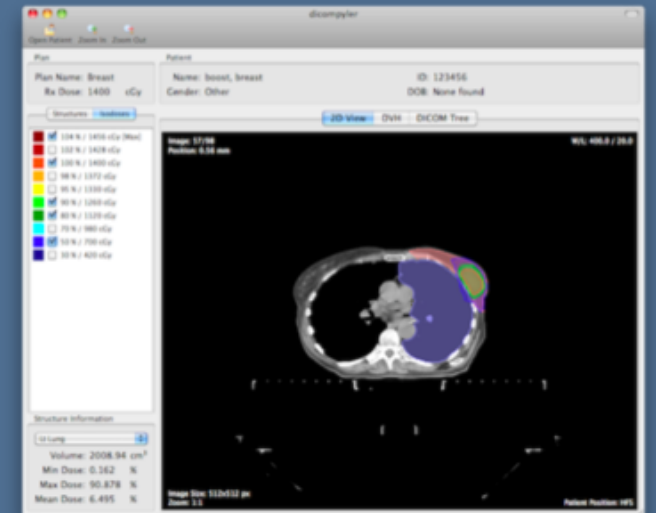
Software Dependencies



pydicom



dicompyler



Shapely



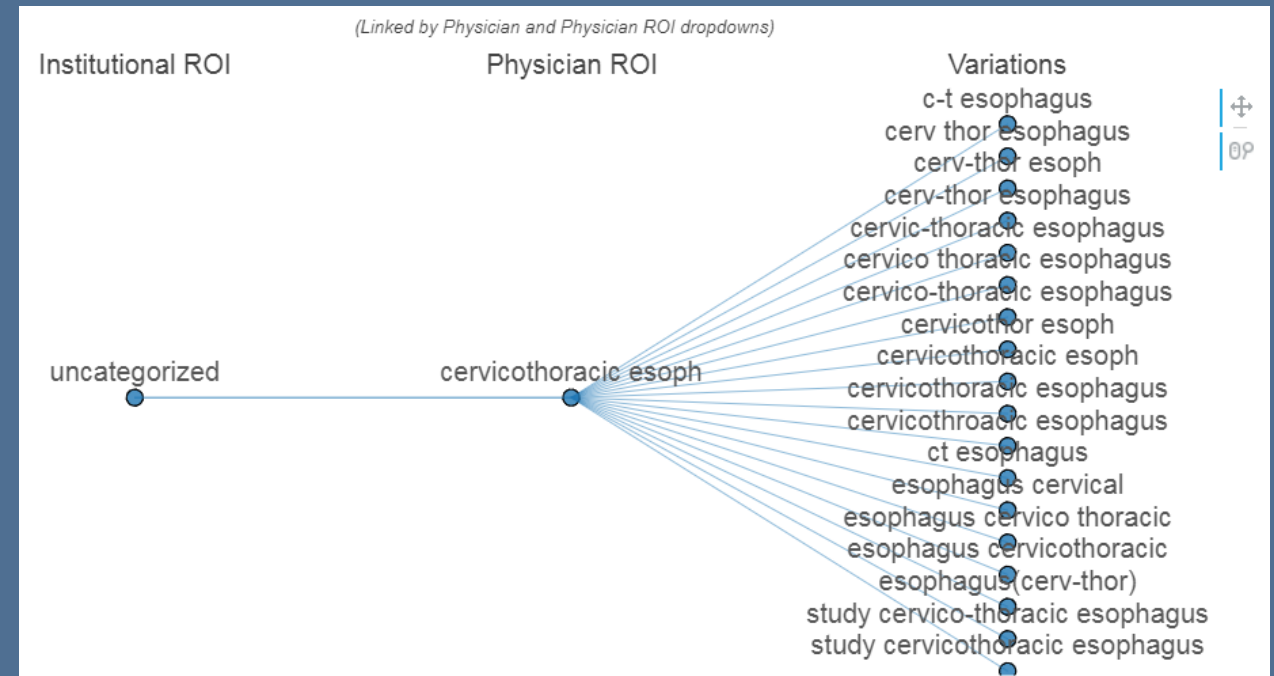
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Database Design

How many ways can you spell esophagus?

ROI Categorization

- An ROI mapping system is implemented that grows with your database (not automatically however)
- System assumes one master list of ROIs for institution.
- Additionally, each physician has their own list, mapped to the institutional list.



Group 1 (Blue) Custom Title:

Group 2 (Red) Custom Title:

Query

Download ▾

Query by Categorical Data

Add Selection Filter

Row

Category 1

Category 2

Group 1

Group 2

☐ Not1 4ROI Institutional Category brachial plexus

Row	Selection Category 1	Selection Category 2	Group	Apply Not Operator
1	ROI Institutional Category	brachial plexus	1	

Query by Numerical Data

Add Range Filter

Row

Category

Min:

Max:

Group 1

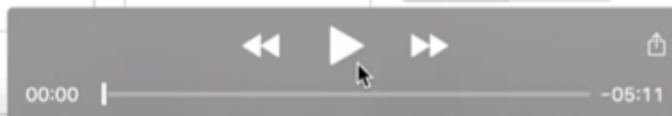
Group 2

☐ NotRx Dose

1000000

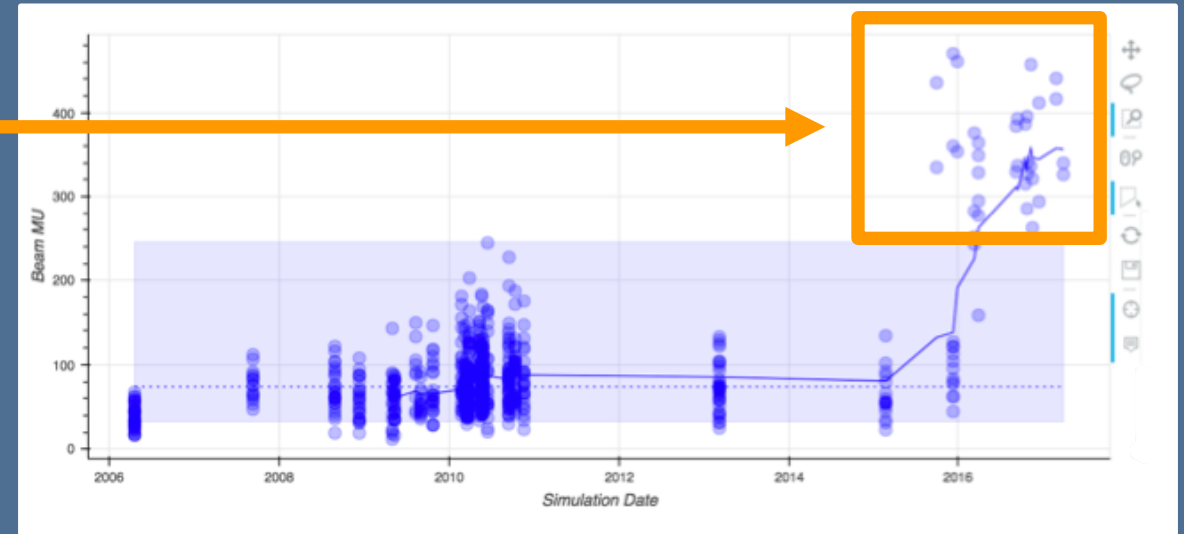
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Row	Range Category	Min	00:00	-05:11	Apply Not Operator
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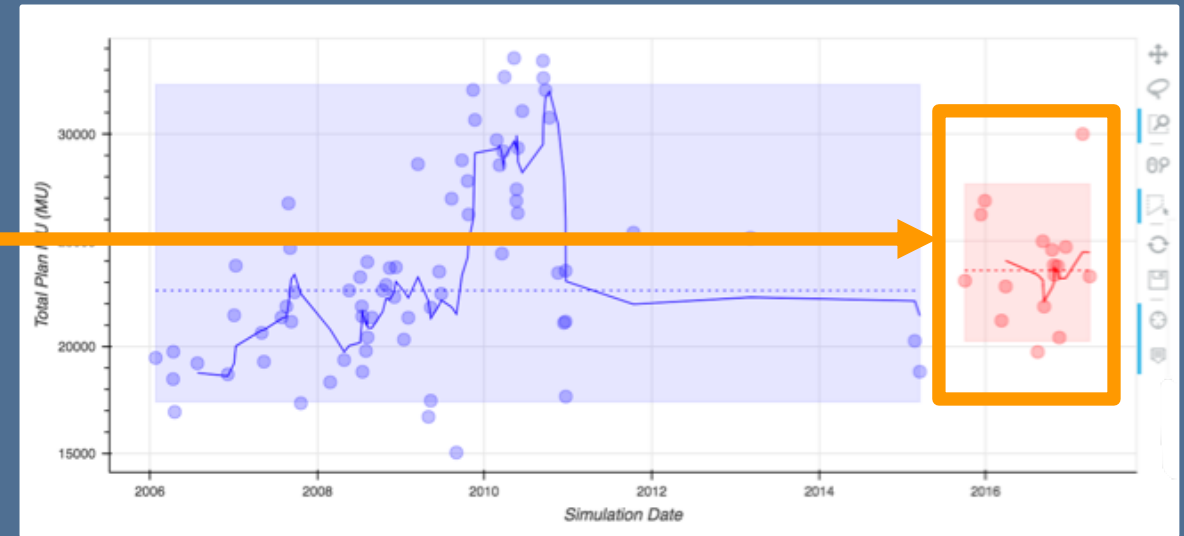


Example: Beam MU vs Sim Date

Beam MU drastically increased, new planner?
Higher modulation?



This clinic transitioned from step-n-shoot to VMAT in 2016. Notably, total MU (rather than beam MU) appears normal.

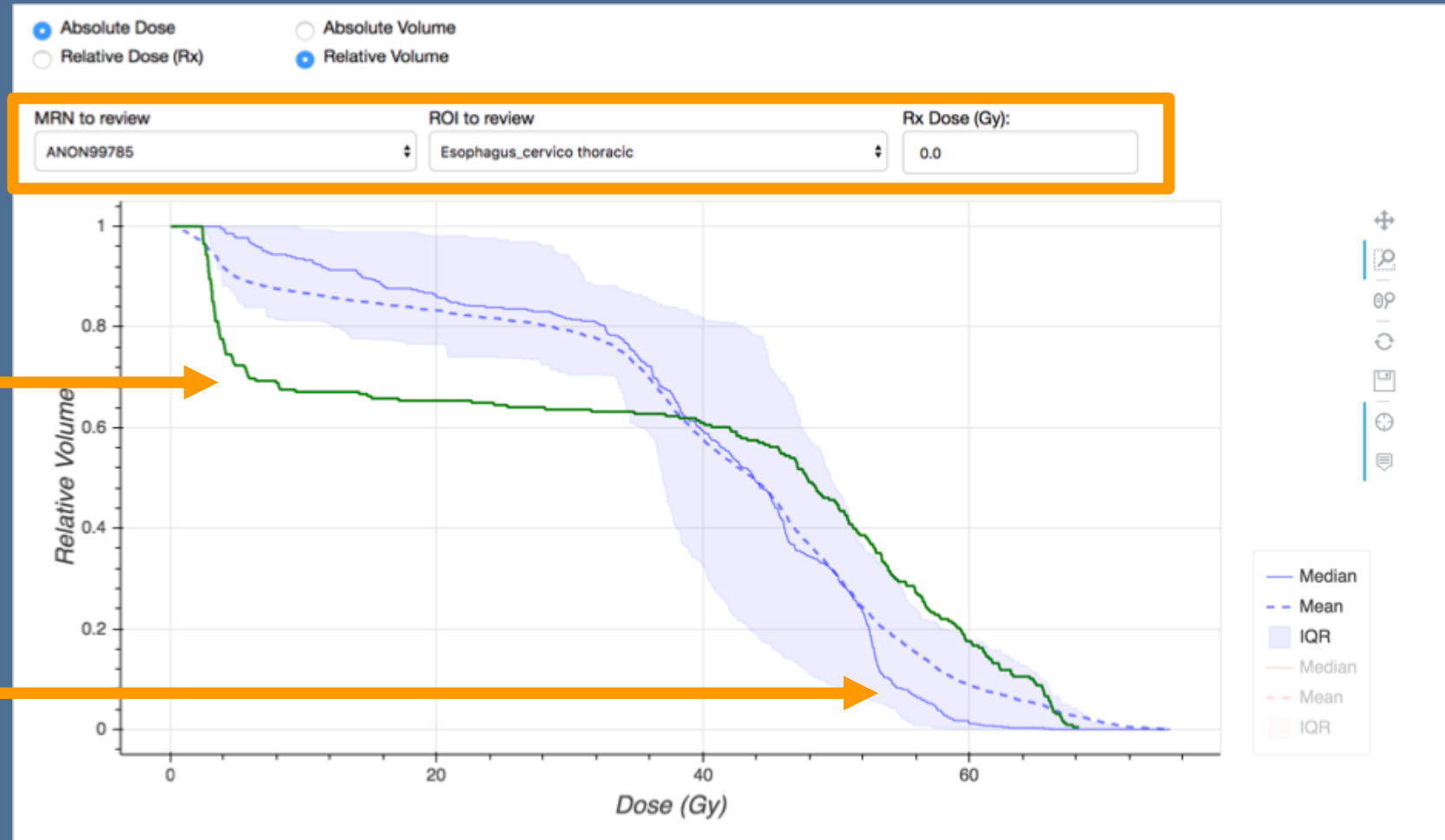


Example: Pre-Approval Plan Evaluation

DICOM Export from
TPS to temporary
review folder

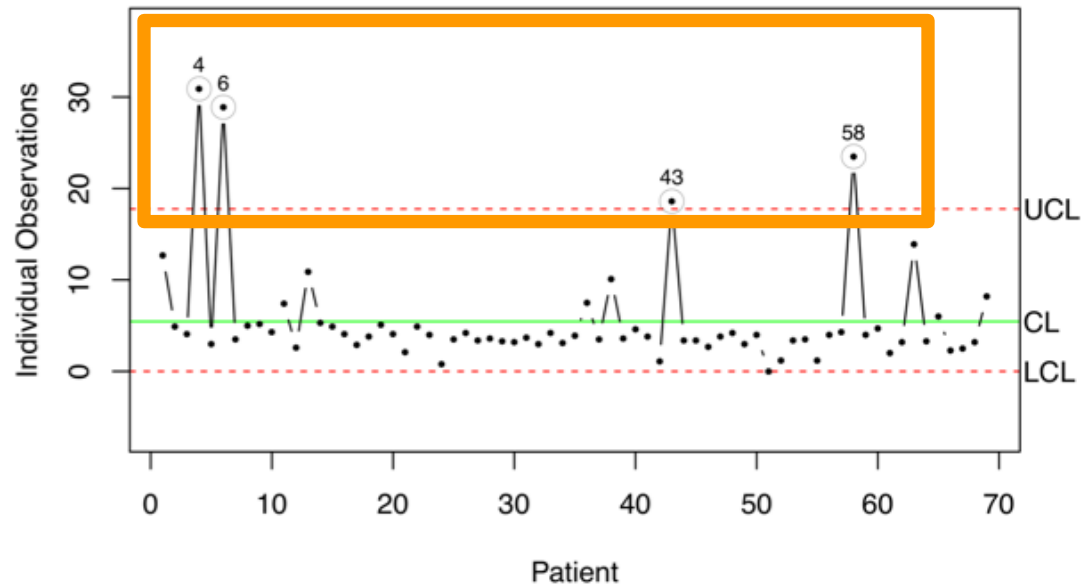
DVH from pre-
approved plan

Mean, median, and
IQR DVHs from
database

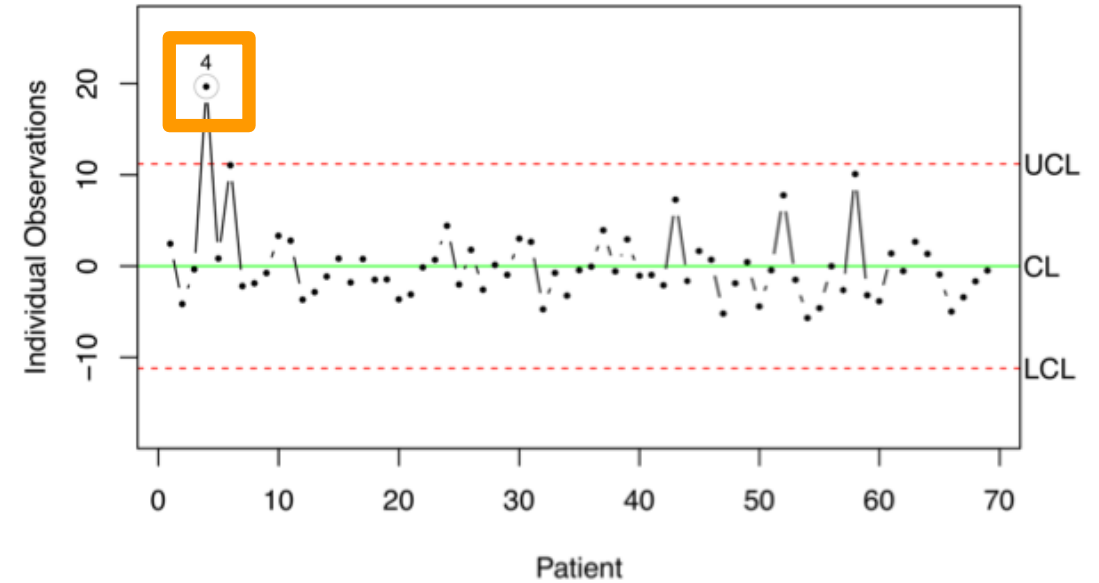


In Development

Quality Control / Chart Checks



Standard Control Chart

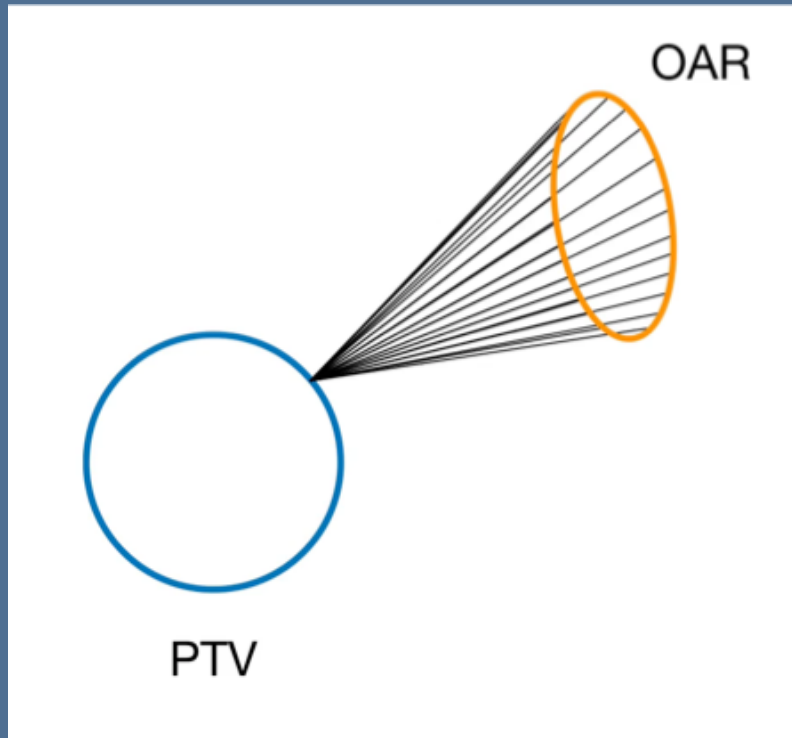


Anatomy Adjusted Control Chart

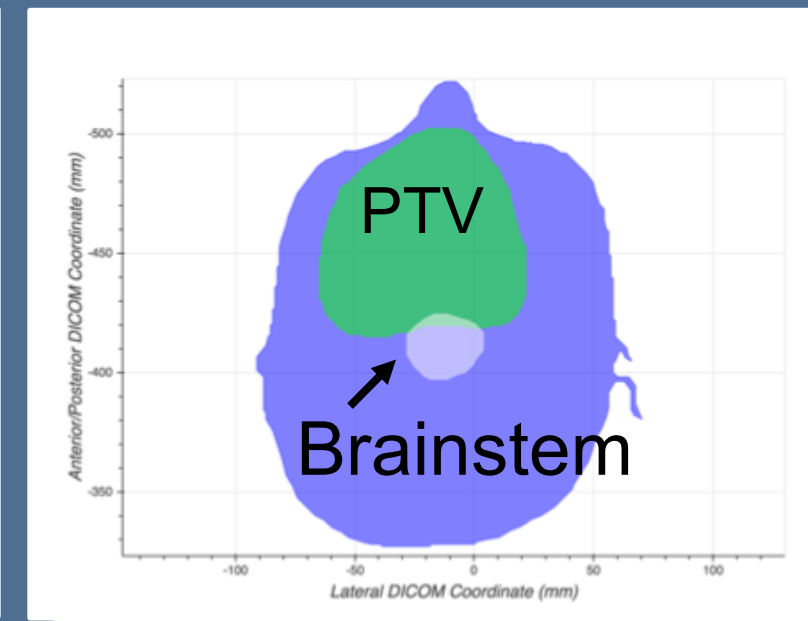
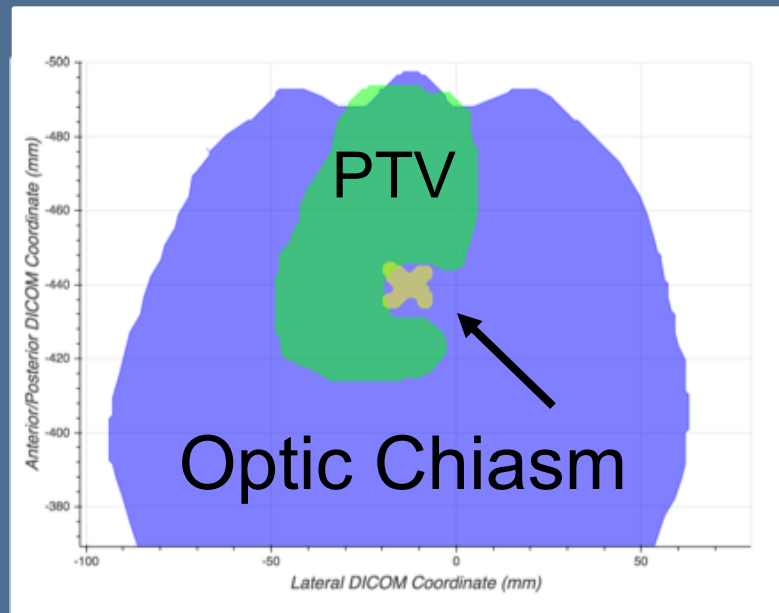
Use database and multi-variable regression models to account for patient-specific anatomy to identify atypical plans.

In Development

Include PTV distance histograms in correlations / models

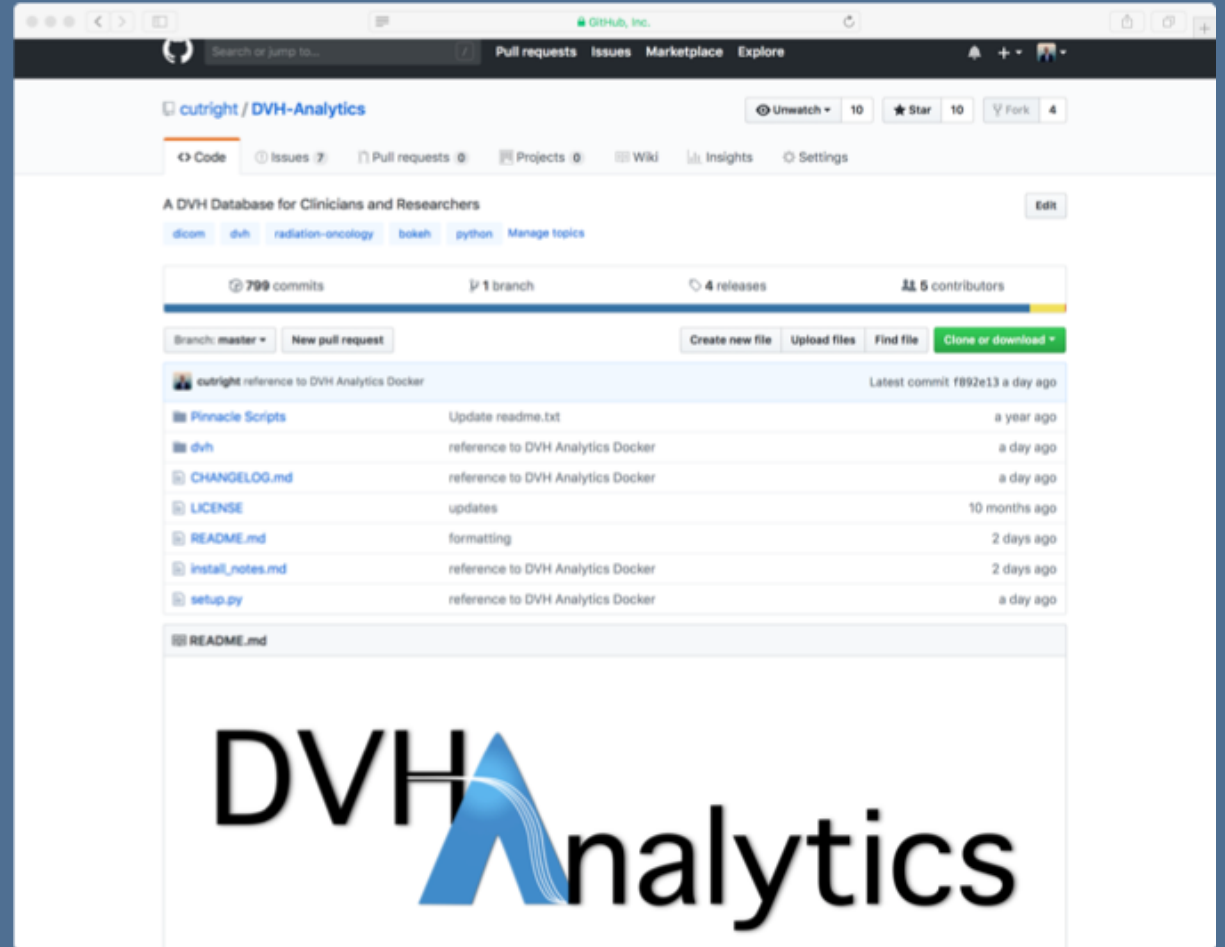


← Already calculated to extract min, mean, median, and max distances



Can I use this software?

- Source code available on GitHub and PyPi:
 - <http://dvhanalytics.com>
 - \$ pip install dvh-analytics
 - You'll need to supply your own Postgres SQL DB
- Available on Docker
 - <http://docker.dvhanalytics.com>
 - Requires Docker to be installed (it's free)
 - Uses docker-compose to start up all web servers and a SQL database
- Keep in mind this is not commercial software, may require some time investment to implement.



Questions?

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