Oncospace

JOHNS HOPKINS

Database sharing model for research and decision support in radiation therapy

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Disclosure:
Funding from Elekta, Philips and Toshiba

Personalized care using database of prior patients

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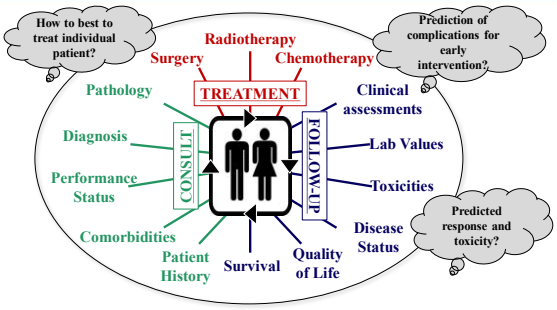

Project components

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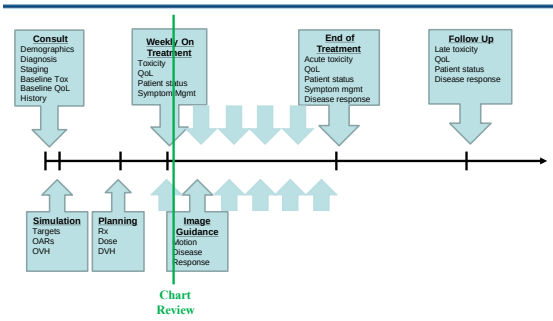
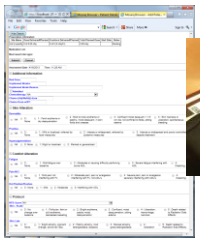
- Integration of data collection with clinical workflow
  - "Big Data" requires meaningful data
- Database design, security and distributed web-access
- Tools for query, analysis, navigation and decision support
  - Sample Questions and Uses
    - Toxicity Trending
    - DVH vs Toxicity
    - Automatic Treatment Planning and Quality
    - Prophylactic PEG use

Treatment Timeline



Data Collection in Clinic

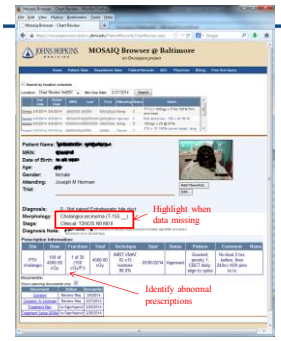
Clinical Assessment

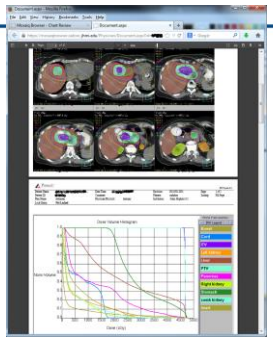


Quality of life

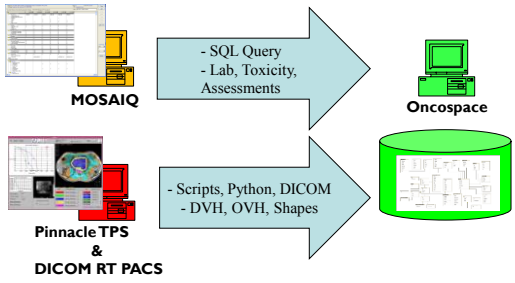
Disease Status

Chart Review (~40 per hour)

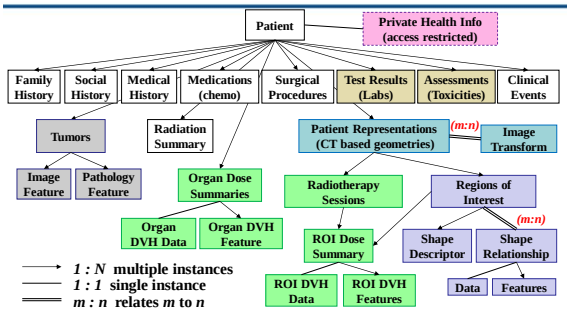




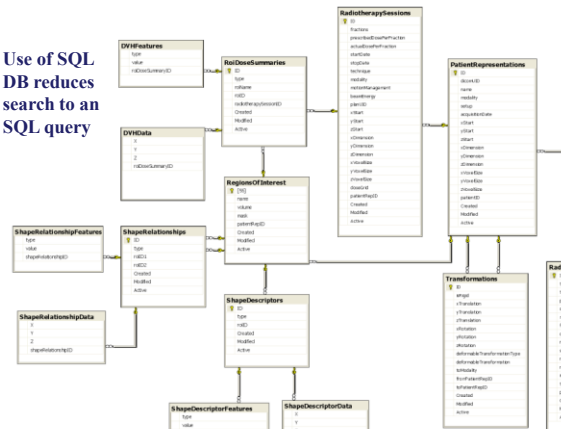
Extract, Transform, Load



Oncospace tables and schema

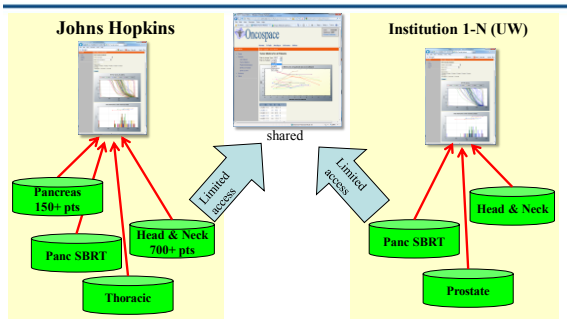


Use of SQL DB reduces search to an SQL query



Designed for data sharing

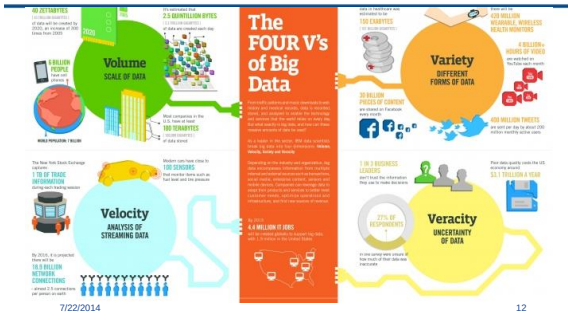
U54 Grant (U Wash, Penn, U Mich)



Informaticist and the Clinician

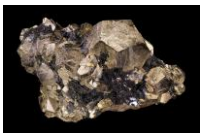
- Where clinical knowledge and informatics science meet?
- What is real knowledge?
- What is NEW knowledge?

The Vs of Big Data



Viability and Value

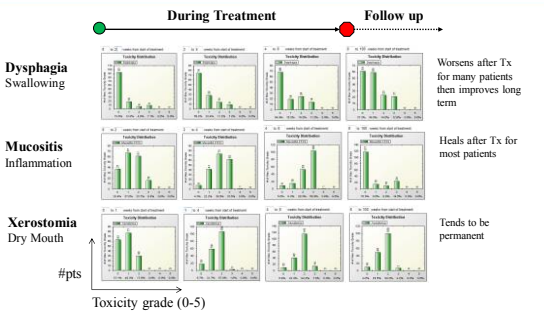
- **Predictive factors must be accessible for new patients**
- **Prediction must be clinically valuable and extend the knowledge of the clinician**



Decision support for…

- **SAFETY** can be improved by alerting users when patient treatment information deviates from normal.
- **QUALITY** can be improved by predicting how well you can do for a patient and seeking to achieve it.
- **PERSONALIZATION** occurs when physicians and patients can review results of prior similar patients and make decisions based on the data specific to the patients needs.

Toxicity trends during and after treatment – detect outliers



Shape-dose relationship for auto-planning

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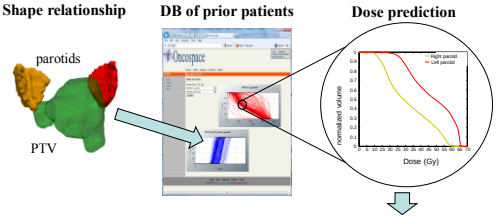
Shape relationship | **DB of prior patients** | **Dose prediction**



- **More efficient plan optimization (10 fold)**
- **Normal tissue doses reduced (5-10%)**
- **Clinically released for Pancreatic Cancer**

Decisions:
Plan quality assessment
Automated planning
Expected toxicities
Dosimetric trade-offs

Flavors of Data

Depends of timeline

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FIXED
already happened

Use to stratify patients

VARIABLE
influence outcome measures

Adjustable to influence outcome?

POPULATION
predict outcome measures

Predict outcome with FIXED and VARIABLE based on POPULATION?

Treatment Timeline

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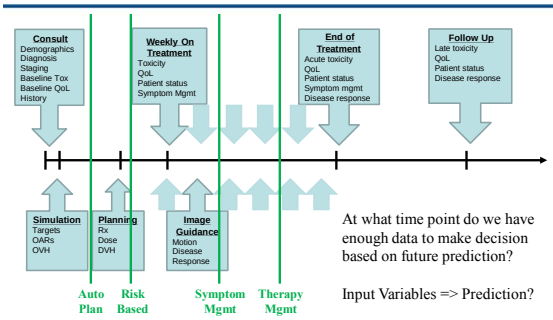
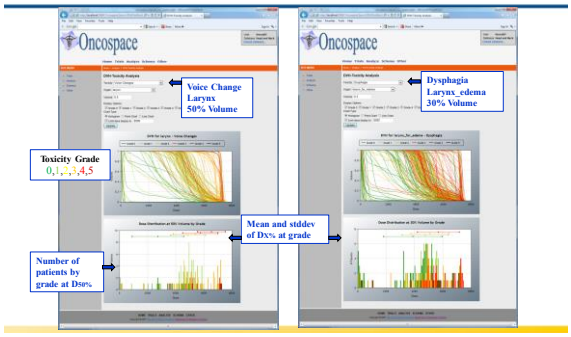


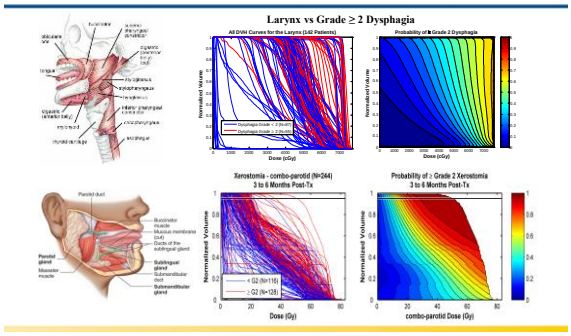
At what time point do we have enough data to make decision based on future prediction?

Input Variables => Prediction?

DVH, Toxicities and Grade distributions

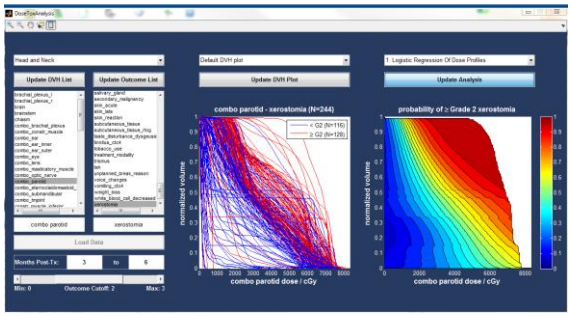


Dysphagia and Xerostomia

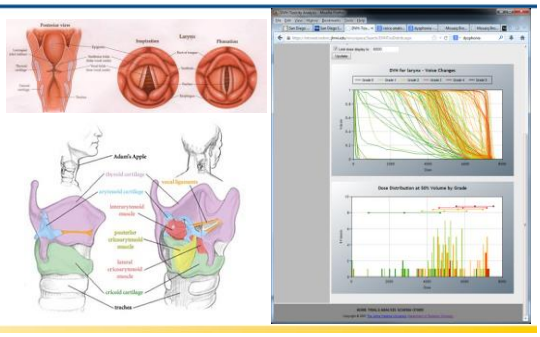


Plugging Into Oncospace

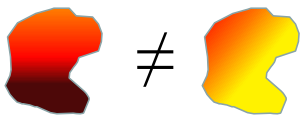
Scott Robertson PhD



Voice Change

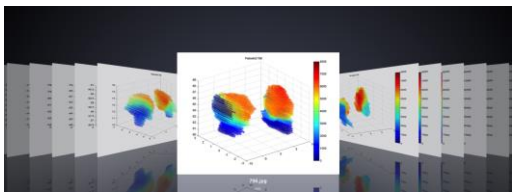


Bad DVH!



- DVH assumes that every sub-region of an OAR has the same radiosensitivity and functional importance to the related toxicity
- DVH assumes that each OAR is uniquely responsible for the overall human function related to the toxicity

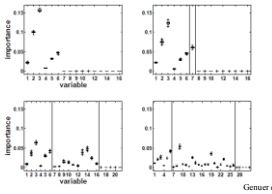
Parotid Data



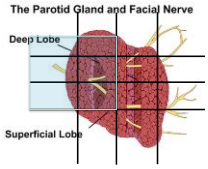
Classification with correlated features: unreliability of feature ranking and solutions

$$VI(X^j) = \frac{1}{ntree} \sum_t (\widetilde{errOOB}_t^j - errOOB_t)$$

Simulation of 1, 10 and 20 variables with a correlation of 0.9 with variable 3

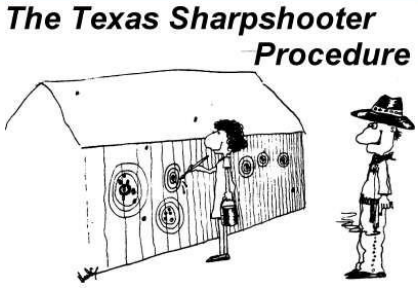


Genuer et al.



http://www.cedars-sinai.edu/

Correlation is not Causation



Acknowledgments

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