Oncospace

JOHNS HOPKINS MEDICINE

Clinical applications of structured databases in radiation therapy

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Disclosure:
Funding from Elekta and Philips

This is NOT a Cloud

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Nomograms

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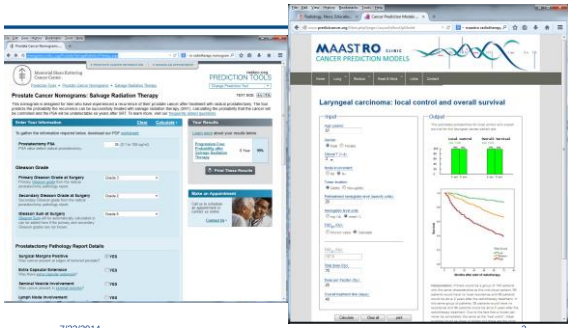
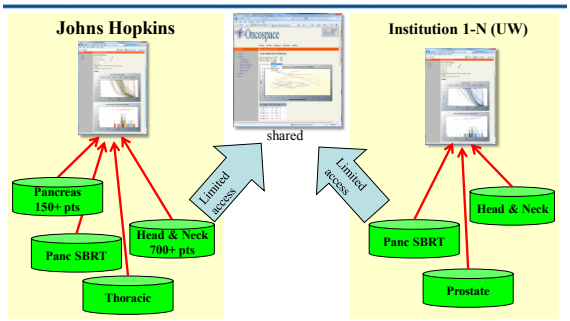
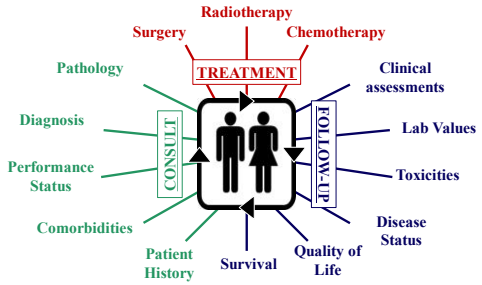


Designed for data sharing



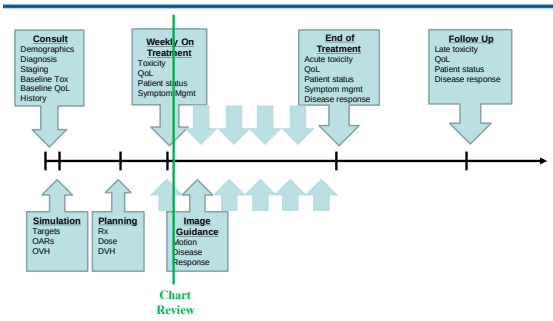
Types of data in radiotherapy



Structured data standards

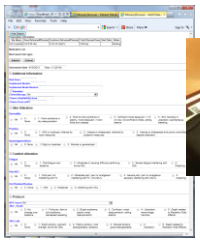
DICOM RT	⟺	Radiation Plans
ICD9 (10)	⟺	Diagnosis
ICD 0	⟺	Morphology
CTCAE	⟺	Toxicity
AJCC	⟺	Staging
LOINC	⟺	Labs/Measures
RxNorm	⟺	Medications
CPT	⟺	Procedures/Billing

Treatment Timeline



Data Collection in Clinic

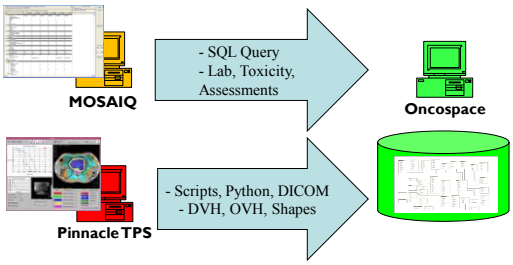
Clinical Assessment



Quality of life

Disease Status

Extract, Transform, Load



Types of databases

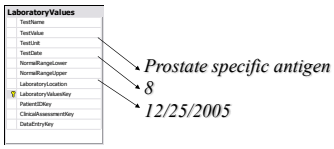
- Relational databases
  - SQL based
  - Tables and their relationships
-
- Object or document oriented databases
  - XML Databases
  - NoSQL

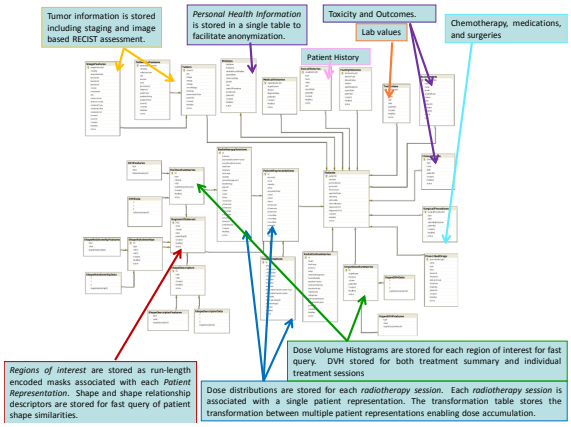
Database Table Design

(Key-Value)

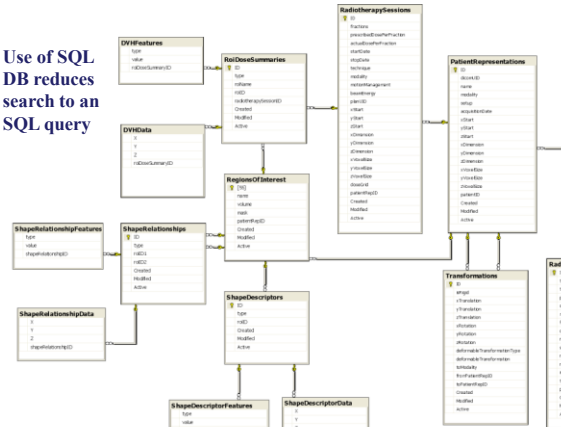
- While there are many types of medical data, there is a much smaller number of classes of medical data (i.e. PSA, K, Her2/Neu are all lab tests)

PSA_VALUE
WBC
CA19-9





Use of SQL DB reduces search to an SQL query



Trivial SQL Lesson

```
SELECT roi.ID, roi.volume
FROM RegionsOfInterest roi
WHERE roi.name = 'r_parotid'
ORDER BY roi.ID
```

Output

ID	Volume
2931	47.0198
2975	23.5393
3009	24.0458
3054	26.6619
3080	64.7959
3123	40.1324
3160	32.7532
3230	24.8615
3250	39.3615
3289	24.6493
3315	40.6475
...	...
...	...
22503	29.54937
22541	39.20649
22585	20.55814
22618	20.83729
22650	13.41712
22686	45.92143
22724	54.63785
22772	26.35064
22809	23.58084
22845	27.07271
22906	33.4442
22967	35.9461

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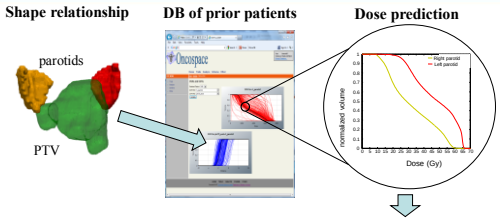
Simple SQL Lesson

```
SELECT roi.ID, roi.volume,  MIN(dvh.X) as dose_to_50
FROM DVHData dvh
INNER JOIN RoiDoseSummaries rds
        on rds.ID = dvh.roiDoseSummaryID
INNER JOIN RegionsOfInterest roi on roi.ID = rds.roiID
WHERE roi.name='r_parotid'
    and rds.type = 'Cumulative DVH, Norm Volume'
    and dvh.Y <= 0.50  -- percent volume
GROUP BY roi.ID, roi.volume
ORDER BY roi.ID
```

ID	Volume	Dose_to_50
2931	47.0198	3257.88
2975	23.5393	2875.21
3009	24.0458	3056.14
3054	26.6619	3466.96
3080	64.7959	2965.67
3123	40.1324	2864.71
3160	32.7532	3226.49
3230	24.8615	2795.85
3250	39.3615	6310.66
3289	24.6493	2858.92
3315	40.6475	2984.79
...	...	...
...	...	...
22503	29.54937	25.96402
22541	39.20649	1161.434
22585	20.55814	6883.384
22618	20.83729	6333.115
22650	13.41712	256.6862
22686	45.92143	2371.552
22724	54.63785	2532.543
22772	26.35064	262.2427
22809	23.58084	2486.008
22845	27.07271	30.98183
22906	33.4442	2538.77
22967	35.9461	3800.48

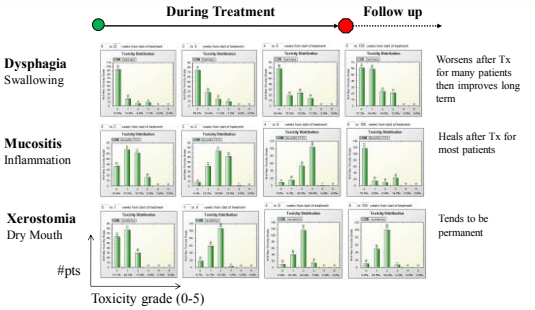
Shape-dose relationship for radiation plan quality



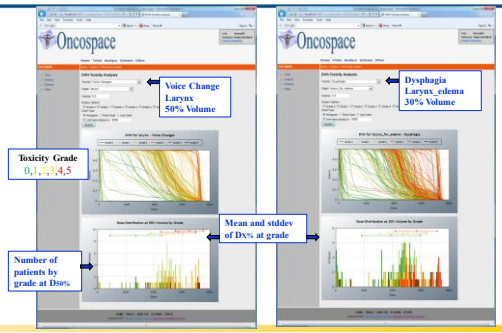
- More efficient plan optimization (10 fold)
- Normal tissue doses reduced (5-10%)
- Clinically released for Pancreatic Cancer

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

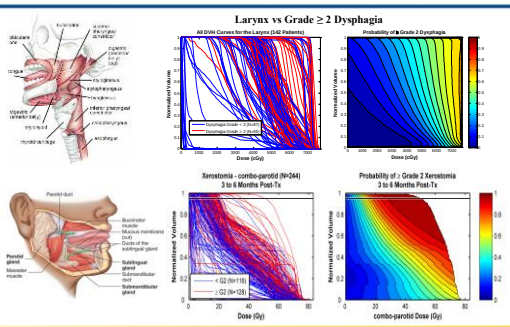
Toxicity trends during and after treatment – detect outliers



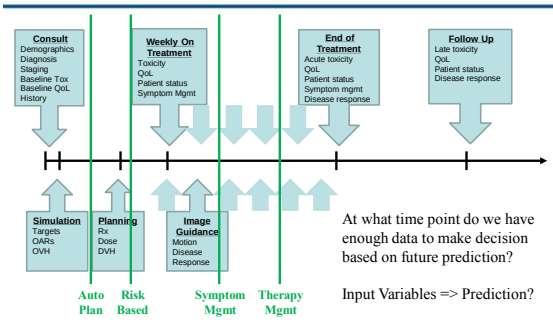
DVH, Toxicities and Grade distributions



Dysphagia and Xerostomia



Treatment Timeline



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

Input Variables => Prediction?

Summary

- The Oncospace model can house RT data effectively and provides a model for sharing
- Data collection in the clinical environment has been demonstrated
  - All patient on trial
- Data exploration and analysis across multitple institutions is possible
- Decision support to improve quality and safety has been demonstrated
- Personalized medicine has not been fully demonstrated, but remains a tenable goal

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