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The Role of a Decision Tree Model to Predict Weight Loss Following Radiotherapy in Head and Neck Cancer Patients

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Oncospace

Purpose/Objectives

- The QOL*1 of the irradiated head and neck cancer (HNC) patient can be significantly affected by toxicities leading to **weight loss**
- To determine the **predictors for weight loss based on the experience of similar** previously treated patients
- To develop **a real-time clinical decision support system** to predict and reduce toxicities with a learning health system (LHS) model

Materials/Methods

- **Oncospace:** an integrated analytic relational database that systematically captures clinical outcome results and all aspects of a radiotherapy treatment plan.
- Retrospective analysis was undertaken using structured data elements (SDEs) that were prospectively acquired during routine clinical care
- **Data**
  - 391 HNC patients from 2007 to 2014 (Table1)
  - 3,015 clinical and dosimetric variables
    - diagnostic ICD-9 code
    - planned DVH*2 at 1% volume increments
    - OVH (Overlap Volume Histogram): distance b/w PTV*3 and OARs*4 on CT Image
    - NCI-CTCAEv4.0 toxicity and QOL

Table. 1 – Demographic data (n=391)

Variable	N (%)
Onset Age, ≥60	169 (43%)
Male	306 (78%)
Caucasian	187 (48%)
Chemotherapy	261 (67%)
T stage, ≥T3	114 (29%)
N Stage, ≥N2	169 (43%)
Site, pharynx	126 (32%)

Materials/Methods (Cont.)

- Method
  - Weight loss of 5kg or more at 3 months post-RT was predicted by the Classification and Regression Trees (CART)
  - **Two prediction models for incremental datasets** (Fig. 1)
    1) at RT planning <u>without</u> variables during RT
    2) at the end of RT <u>with</u> variables during RT

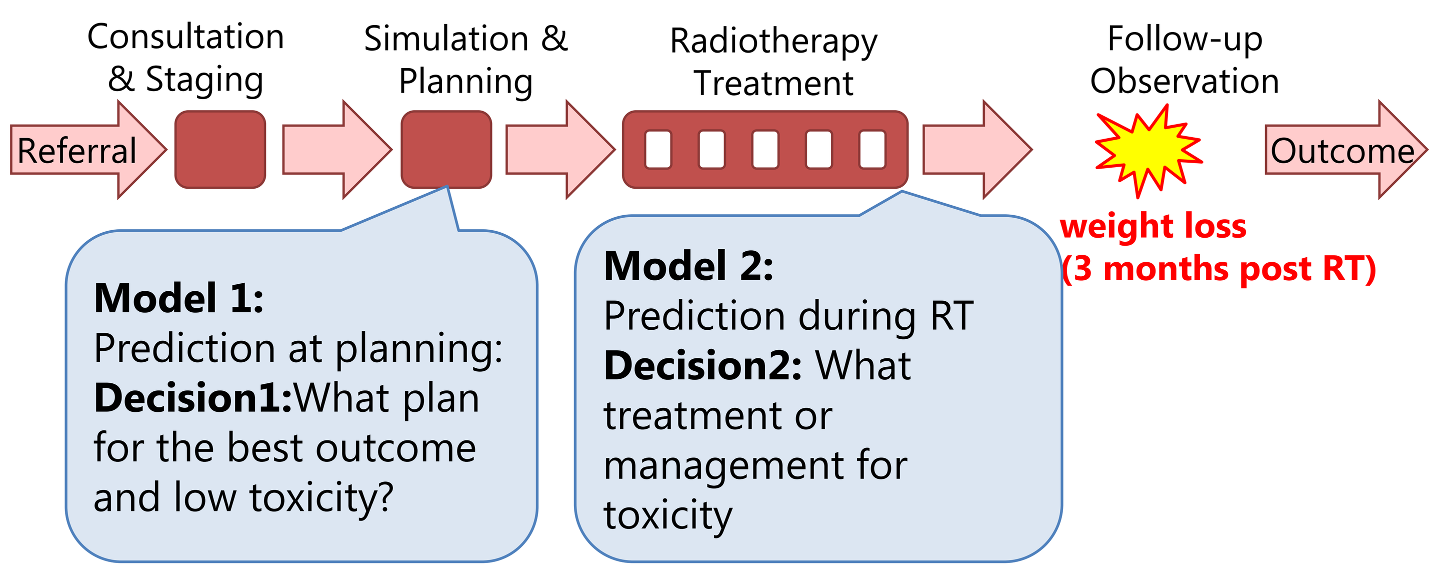

Fig. 1 – Two prediction models before/during treatment

Results

- Weight loss predictors at <u>RT planning</u> (Fig. 2)
  - AUC*5 0.773
  - Sensitivity 0.766, PPV*6 0.426
  - Predictors:
    - **(1: Dosimetry)** dose to masticatory muscle, larynx, parotid
    - **(2: Diagnosis)** ICD-9 code
    - **(3: Patient)** age

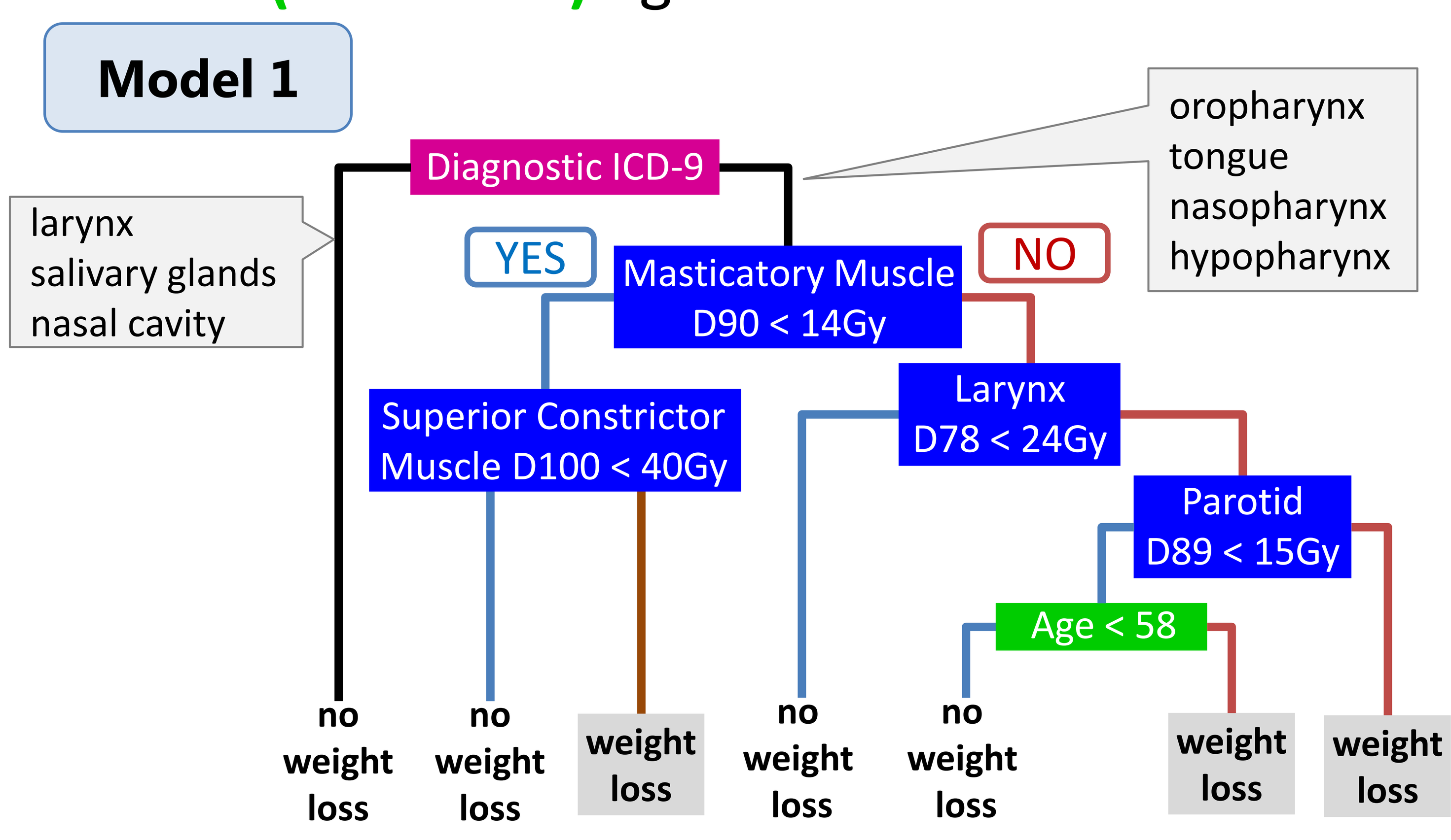

Fig. 2 – Weight loss prediction model at planning

*1 QOL: Quality of Life, *2 DVH: Dose Volume Histogram,
*3 PTV: Planning Target Volume, *4OAR: Organ at Risk,
*5 AUC: Area Under Curve, *5 PPV: Positive Predictive Value

Results (Cont.)

- Weight loss predictors <u>during treatment</u> (Fig. 3)
  - AUC 0.839
  - Sensitivity 0.988, PPV 0.467
  - Predictors:
    - **(1: QOL)** patient reported oral intake
    - **(2: Diagnosis and staging)** ICD-9, N stage
    - **(3: Dosimetry)** dose to larynx, parotid
    - **(4: Toxicity)** skin toxicity, nausea, pain
    - **(5: Geometry)** minimum distance between PTV and larynx

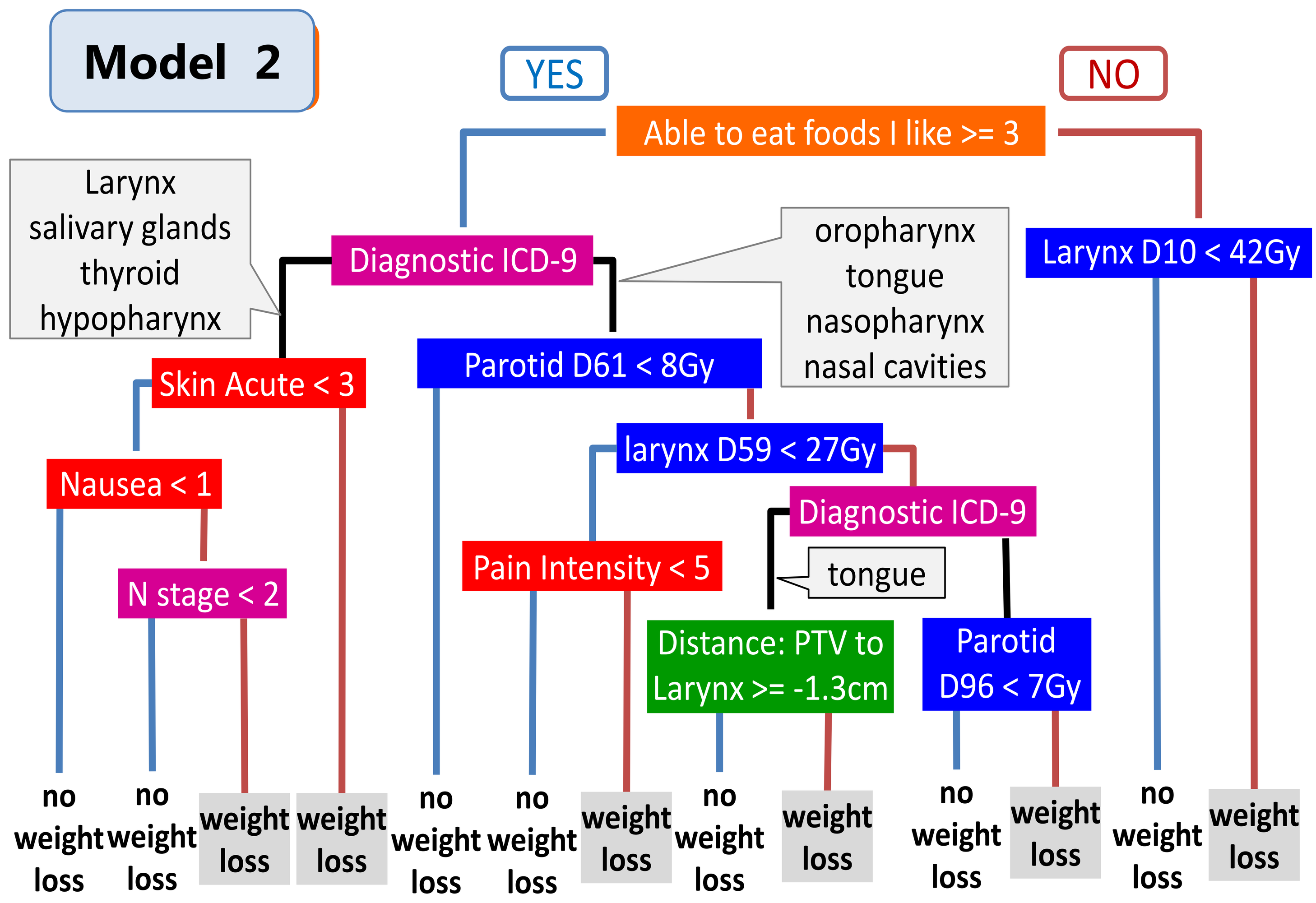

Fig. 3 – Weight loss prediction model during treatment

Conclusion

- Systematic capture of SDEs and data-mining tools facilitated a decision-support analysis tool for weight loss based on past similarly treated patients
- The two prediction models at RT planning / treatment
  - identified the importance of Patient Reported Outcome
  - showed the potential for a real-time decision-support (e.g. prophylactic feeding tube placement)
- Future work: evaluating models in the clinical settings; imaging features might be helpful to improve PPV