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

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Purpose/Objectives

- The QOL1 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 (Table 1).
  - 3,015 clinical and dosimetric variables:
    - diagnostic ICD-9 code.
    - planned DVH1 of 1% volume increments.
    - OVH (Overlap Volume Histogram): distance b/w PTV3 and OARs4 on CT Image.
    - NCI-CTCAEv4.0 toxicity and QOL.

Results (Cont.)

- Weight loss predictors during treatment (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.

Table 1 – Demographic data (n=391)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset Age, ≥60</td>
<td>169 (43%)</td>
</tr>
<tr>
<td>Male</td>
<td>306 (78%)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>187 (48%)</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>261 (67%)</td>
</tr>
<tr>
<td>T stage, ≥T3</td>
<td>114 (29%)</td>
</tr>
<tr>
<td>N Stage, ≥N2</td>
<td>169 (43%)</td>
</tr>
<tr>
<td>Site, pharynx</td>
<td>126 (32%)</td>
</tr>
</tbody>
</table>

Fig. 1 – Two prediction models before/during treatment.

Fig. 2 – Weight loss prediction model at planning.


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.