MAAS-PlanScorecard GUI and API: a Feature Rich, Publicly Available, Shared Source Code Tool to Create, Modify and Evaluate Dosimetric Scorecards for a Single Patient, Multiple Patients in Batch or in Custom Application via API

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AIM

To develop a free and maximally accessible tool allowing researchers and clinicians to express dosimetric treatment plan quality in a precise and potentially comprehensive manner. The tool supports common volume at dose, dose at volume, mean dose, dose index, and other popular DVH based metrics accompanied by piecewise linear scoring functions to quantify relative importance of intrametric specific dose, volume or index levels. Relative scores assigned to each metric represent preference, tradeoff or a specific clinical intent; while zero points for any single metric indicates a strict protocol violation. Ultimately, metrics are summed as the total reported score for a specific dose or plan. This tool is accessible either from the interactive UI or by exposing C# class libraries via supplied API.

METHOD

Eclipse Scripting Application Programming Interface (ESAPI) and Visual Studio 2022 C# programming language were used. Features include:

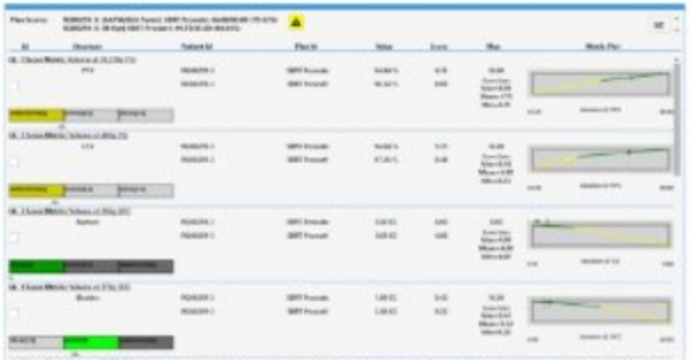
- Auto-create derived structures with in-metric nested Boolean and asymmetric expansion support in an intuitive UI with advanced multi-stage structure derivation expressions
- Normalize plan dose for maximum score, either single patient or in multi patient batch
- Multiple methods for structure name matching including an external user editable dictionary seeded with TG263 names
- An in-app DVH view to see scoring metric D@V and V@D metrics plotted over a DVH as horizontal or vertical lines
- Optional automatic global dose scaling when current scorecard is defined for a different prescription than the loaded plan
- PDF screen print and raw CSV scoring output.

Main GUI screen for Scorecard tool

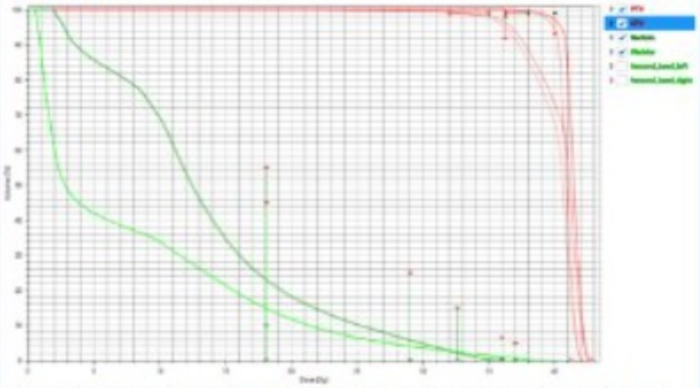
RESULTS

Full documentation and precompiled binaries are available on GitHub [1]. Source code is shared under the Varian Limited Use Software License Agreement. In a separate repo, PlanScoreCardAPI has instructions for integrating the scoring evaluation into other projects.

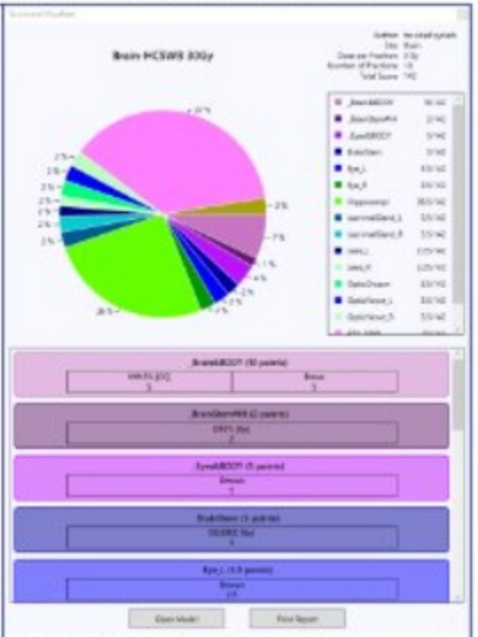
Example of normalization to max score (rather than a specific target coverage level) for a prostate SBRT case. Plan was automatically copied and normalization level of 98.7% found within a user definable search range (i.e., 80-120%). A higher score of 69.8 points vs original 66.0 achieved due to increased target coverage. This function can be used in custom ESAPI projects via API to efficiently normalize large groups of plans for dosimetric quality informed score standardization.



Both plans are plotted on piecewise linear function with score on the Y-Axis and evaluated metric on the X-Axis.



Both plans are represented in DVH view with scorecard metrics plotted as lines.



Example of scorecard API usage: The PlanScoreCard API was used in the development of a custom application to help generate and visualize dosimetric scorecards (not treatment plans). The API was added to the project and allowed the developer to read the scorecard json file directly into the native plan scorecard class model. This easily exposes necessary properties to gather data from a scorecard. Information is then presented to the user in an informative and intuitive manner (pie-chart). Additionally, by using the API to develop a separate application, this project severs any dependency on ESAPI dlls. Doing so allows users to run the application on any computer, outside of the Eclipse environment.

CONCLUSIONS

Dosimetric scorecard uses established dosimetric plan scoring methods [2]. Innovations are: A) utilizing these methods directly from the treatment planning system with GUI or other custom software via API; B) doing so without cost; C) ability to add features or fix bugs. Barrier to entry is low with precompiled binaries posted and installation instructions [1]. Supports being used without "scripting approval" (in read only mode) where patient data cannot be modified.

Scorecards have been used for planning competitions [2], retrospective plan quality analysis [3], creating high-quality RapidPlan models [4], quantifying performance of various beam arrangements [5] and tuning Ethos clinical directive templates [6]. Furthermore, a well-constructed dosimetric scorecard can act as a high-level utility function for an inverse dose optimizer that supports piecewise linear functions to directly optimize plan quality.

MAAS-PlanScorecard is under active development with a full roadmap posted. The authors invite collaborators to use the tool in their clinic (via GUI or API), publish research results with dosimetric scorecards and modify source code with improvements and features via Pull Request.

REFERENCES

[1] GitHub > https://github.com/Varian-MedicalAffairsAppliedSolutions/MAAS-PlanScoreCard
[2] Nelms, et al > https://doi.org/10.1016/j.prro.2011.11.012
[3] Rayn, et al > https://doi.org/10.1016/j.adro.2023.101295
[4] Liu, at al > https://doi.org/10.1016/j.meddos.2022.04.003
[5] Rayn, et al > https://doi.org/10.1002/acm2.14295
[6] Rayn, et al > https://doi.org/10.1016/j.adro.2024.101550

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