

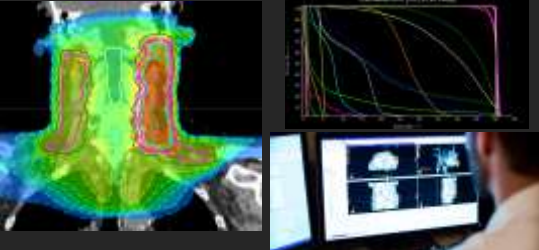
Intelligent Automation for Treatment Planning Workflows


Greg Robinson, MS, CMD, RTT Sun Nuclear Corporation

© 2018 Sun Nuclear Corporation. All rights reserved. SUN NUCLEAR CORPORATION

Logos for Microsoft Office (Word, Excel, PowerPoint, Outlook) and IBM are visible at the bottom left.

Defining Quality- Where have we been?






"Without data you're just another person with an opinion."

- W. Edwards Deming, Data Scientist

Quality Scale – Where are we?

Quantitative Qualitative

But Where Are the Largest Sources of Variation?

PER PLAN PER PRACTICE

Valuation (CT, MR, PET) Agency Consulting Planning, Inc. (Dose Optimization) Quality & Review (Plan Quality) Prescription Dose QA

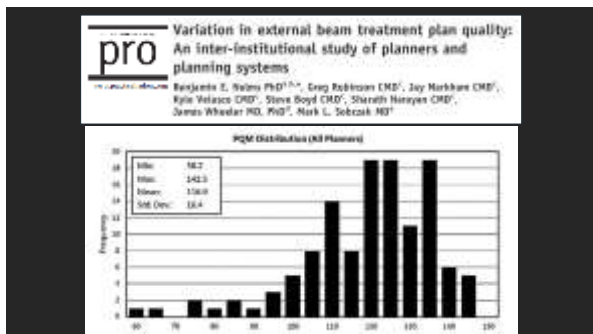
Patient Setup
Dose Delivery
Image Guidance (IGRT)
Adaptive Planning

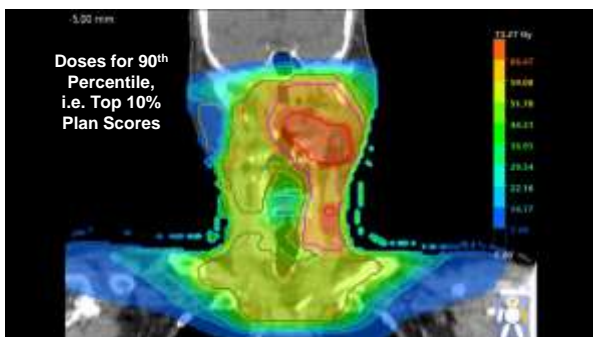
History of Modern Plan Studies

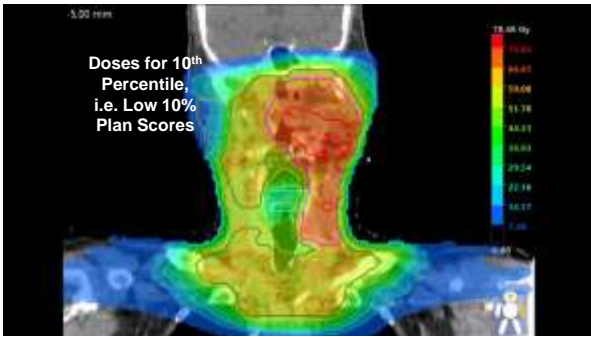
1990 1995 2000 2005 2010 2015

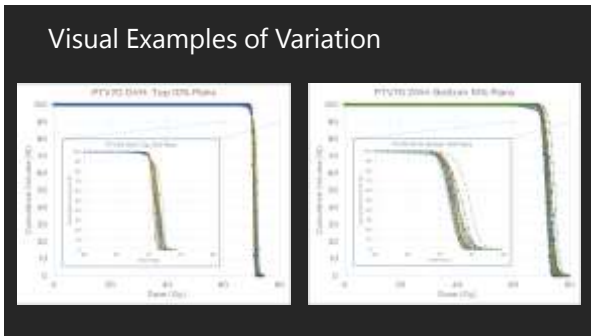
World Map

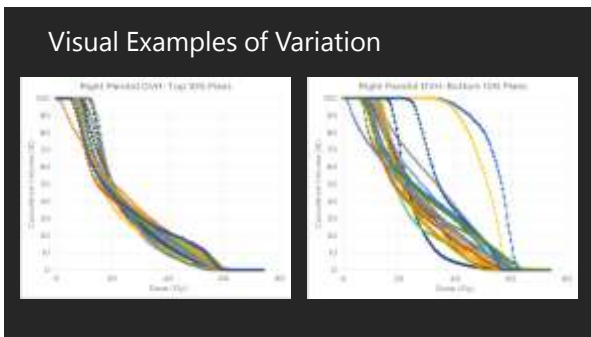






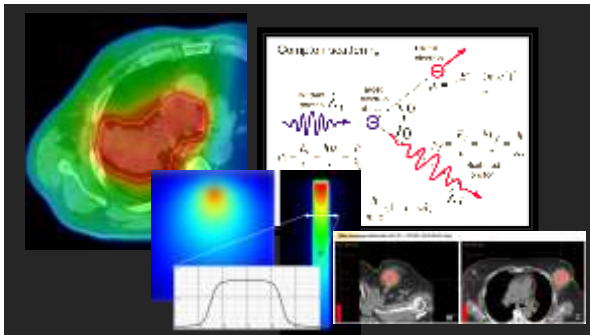




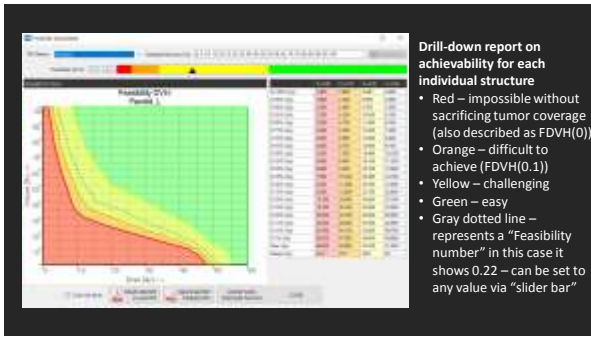


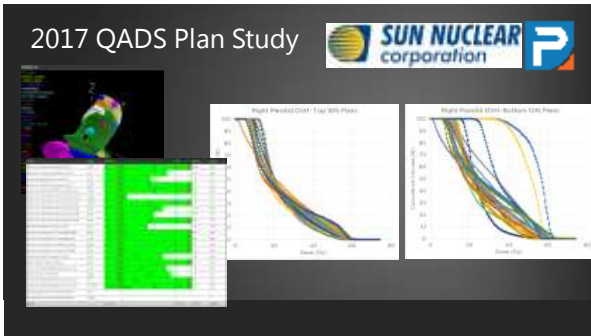
What is possible?

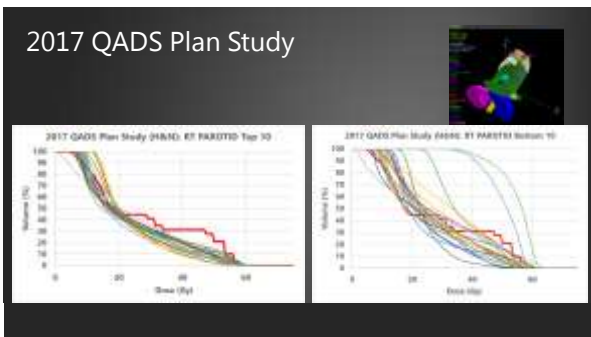




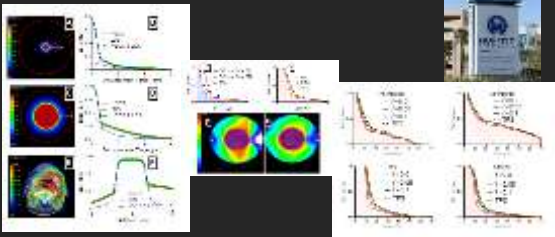






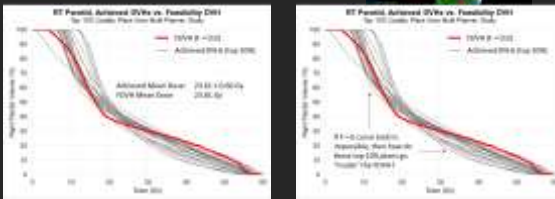


What about the Accuracy of Feasibility?

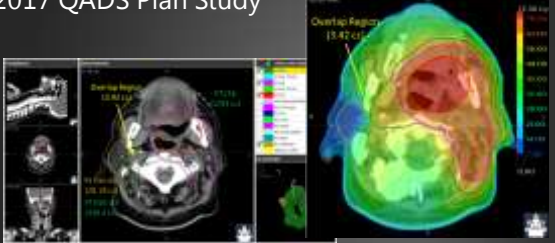


A novel method for a priori estimation of best feasible DVH for organs at risk: Validation for H&N VMAT planning
Ahmed et al.

2017 QADS Plan Study



2017 QADS Plan Study



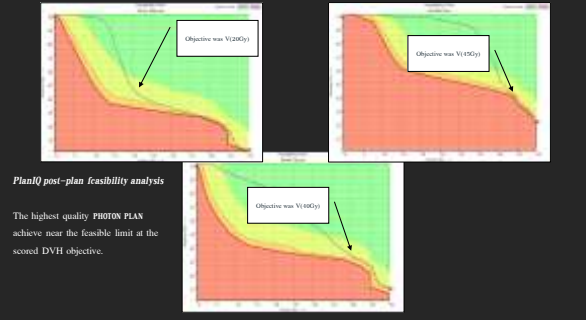
2018 QADS Plan Study: Overall Winner (Plan + QA)

Jonathan Stenbeck
Greenville Health Systems (USA)
VMAT, 4 beams, 10 MV, 967 MU
Eclipse TPS



PlanIQ post-plan feasibility analysis

The highest quality PHOTON PLAN achieve near the feasible limit at the scored DVH objective.



2018 QADS Plan Study: Overall Winner

Dennie Franssen
Holland PTC
Proton, 4 beams
RayStation TPS



Plan/Q post-plan feasibility analysis

The highest quality **PROTON PLAN** drives down to feasible limit along the whole curve.

Even though feasibility analysis is designed for photons, it works well for proton plans.

UNC SCHOOL OF MEDICINE

"Tools capable of providing predictions of what is dosimetrically achievable (and ideally optimal) are greatly needed in radiation treatment planning in order to reduce plan variability and ensure quality."

Fried et al. JACMP, 2017

Journal of Applied Clinical Medical Physics

UNC SCHOOL OF MEDICINE

Designing a radiation plan that **optimally** delivers both target coverage and normal tissue sparing is challenging. There are **limited tools** to determine what is dosimetrically achievable and frequently **the experience of the planner/physician** is relied upon to make these determinations"

Fried et al. JACMP, 2017

Journal of Applied Clinical Medical Physics

Jumpstarting Knowledge-based Planning

Efficiently train and validate a RapidPlan model through APQM scoring

Marco Fatella, ^{1,2*} Alessandro Scoppia, ¹ Nicola Piana, Marco Antonio Puccato, Antonietta Zoc, and Maria Piazzola
¹INFN Sezione di Padova, ²INFN BECS, Padova 35129, Italy
 (Received 30 November 2017; revised 23 March 2018; accepted for publication 21 March 2018; published 28 March 2018)

"Forward feeding a RapidPlan model through a thresholding selection based on APQM% is proven to produce equal or better results than a (traditional) model"

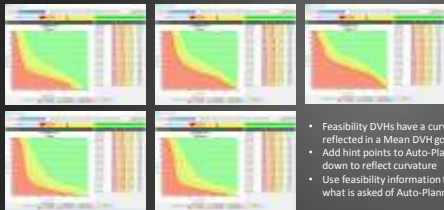
MIT Plan Quality Assessment Using Pinnacle's Auto-Planning and Risk Reducer Corporation's Plan3 Plan Evaluation and Feasibility

Conclusions
 With the use of PlanIQ feasibility goals and Pinnacle³ Auto-Planning, quality treatment plans in relation to target volume coverage and sparing of critical structures, as compared to those created by a highly experienced medical dosimetrist, were achievable with one iteration. With the use of more iterations, a better, rather than an adequate plan can be obtained.

Progressive optimization algorithm

- Drives target coverage and sparing to the limits

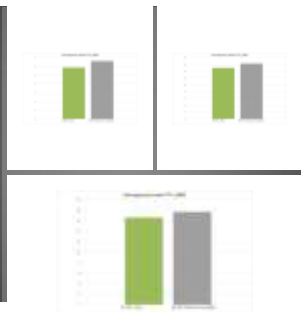
Feasibility Aiding Clinical Decision Making



- Feasibility DVHs have a curvature that is not reflected in a Mean DVH goal
- Add hint points to Auto-Planning to have it drive down to reflect curvature
- Use feasibility information to drive priorities and what is asked of Auto-Planning

Average Results Over 10 Cases: AutoPlanning + Feasibility

- Used NRG-002 HN Protocol for analysis, target homogeneity decreased when pushing sparing with Feasibility, however still well within allowed values in protocol



Average Results Over 10 Cases: AutoPlanning + Feasibility



Intelligent Automation Through Dose Prediction

Conclusions

- Quality must be objectively defined to responsibly automate treatment planning
- Objective analysis of clinical metrics may not account for patient complexity
- PlanIQ Feasibility uses physics-based principles to provide knowledge of what is possible per patient
- Personalizing optimization inputs through PlanIQ Feasibility based dose objectives can drive out variability and improve quality
- PlanIQ Feasibility can provide objective plan reviews for physician and physics team based on personalized patient-specific goals





Thank You,
Questions?