

Use Advanced Planning Tools to Improve Plan Quality, Efficiency, and Consistency

Ping Xia, Ph.D.
Professor of Molecular Medicine
Cleveland Clinic, Cleveland, OH



Disclosures

- Philips: Research Grant





Dr. Verhey was the Chief Physicist in Radiation Oncology at UCSF from 1991-2008

My Concerns 23 Years Ago

- In 1995, I became the third medical physics resident at UCSF.
- I was told that I could be the last one because the department had some doubts about the value of medical physics residents.

Dr. Verhey's Advice

- Go to clinic daily (attend chart round, clinical conferences).
- Be Involved in treatment planning.
- Demonstrate the values of physics residents.
- Do research: a systematic approach to solve clinical problems.

Your Concerns 23 Years Later

- Can some of the physicist positions be replaced by physics assistants due to financial pressure in current health environment?
- Can some of the physicist positions be replaced by computer automation or artificial intelligence (AI)?

Medical Physics 3.0

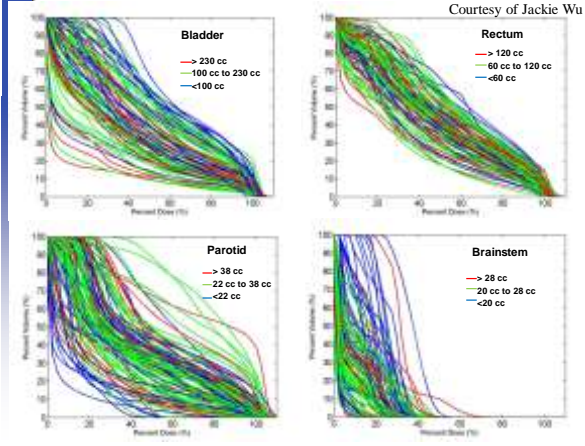
- One of three pillars in medical phys. 3.0 is treatment planning.
- How to be involved in treatment planning?
 - It is not a physics job.
 - It is what dosimetrists do.
- Physicists should lead the dosimetry group to advance treatment planning.

Advance Planning Tools

- Use and Implement advanced planning tools to improve plan quality, efficiency, and consistency.
 - Knowledge based planning (KBP)...
 - Automatic planning (Auto, AP)...
 - Multiple criteria planning (MCO)...

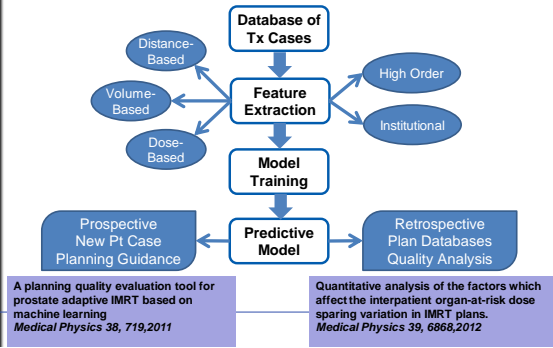
How Does Knowledge Based Planning Work?

Courtesy of Jackie Wu



Courtesy of Jackie Wu

Modeling Planning Knowledge



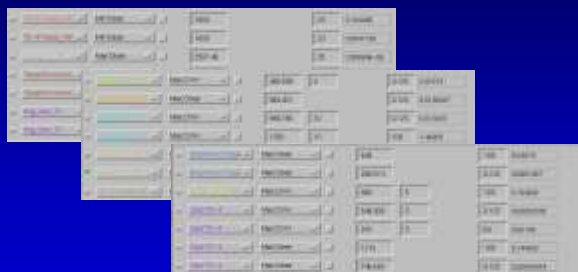
How Does Auto Planning Work?

Auto-Planning in Pinnacle System

- Mimics the planners' thought process
- Utilizes the planners' tricks to create surrounding structures and tuning contours automatically
- Automatically runs multiple loops while adjusting planning objectives – similar to what planners manually do



Automatic Created Planning Objectives

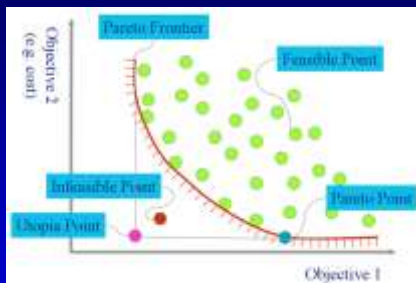


Advance Tool Setting



Multi-Criteria Optimization (MCO)

Pareto Frontier



Courtesy of Jeremy Donaghue www.noesisolutions.com/Noesis/sites/default/files/Pareto_Front.png

MCO Implemented in RaySearch

- Requires a set of dose constraints (anchor points) – no violation allowed.
- Requires a set of dose objectives (tradeoffs) – negotiations allowed.
- Multiple $(2n+1)$ plans are created automatically according number (n) of tradeoffs.
- Users can lock the satisfied tradeoffs to narrow the search space.

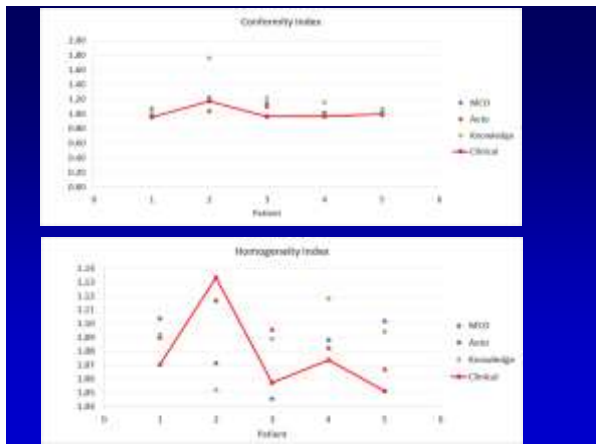
Navigation Panel

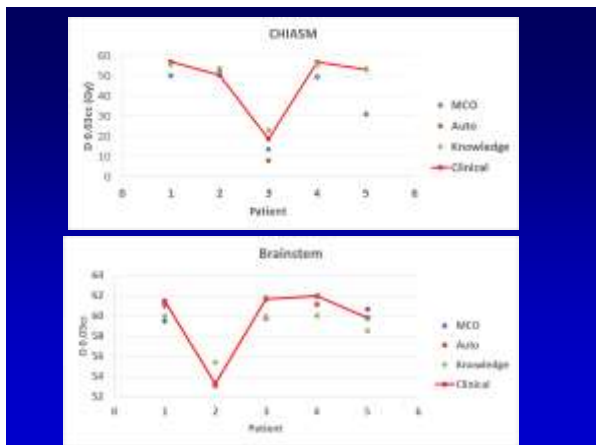


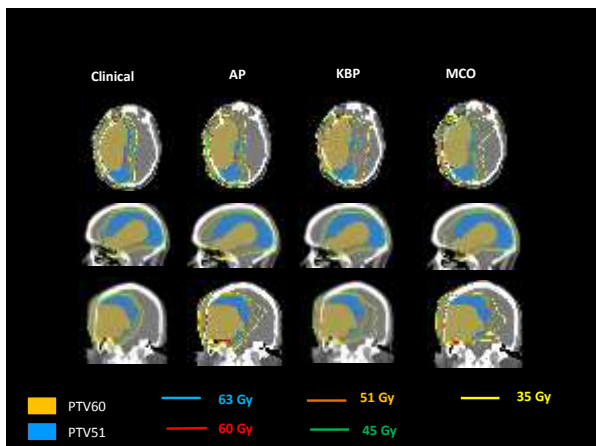
Can Advance Planning Tools Improve Plan Quality, Consistency, and Efficiency?

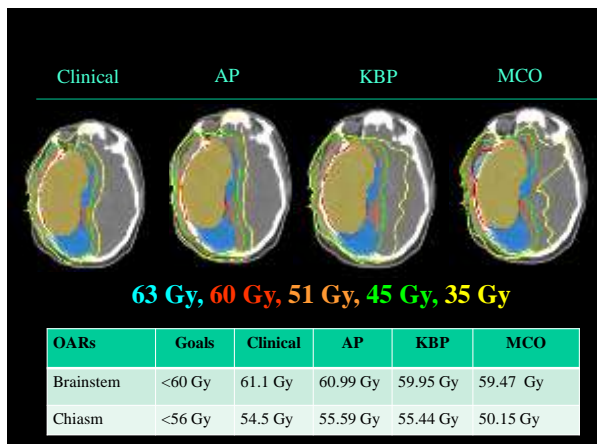
- Selected four clinically challenging sites, physicists from three institutions use knowledge based planning (KBP), auto-planning (AP), and MCO tools to plan the same 20 cases (5 each) from partial brain, prostate + LN, HN, and spine SRS.
- Each institution received a general planning guideline for each site, including Rx, OAR tolerance.
- It is more challenging for MCO and KBP institutions because the selected cases were from the AP institution.

Partial Brain Cases

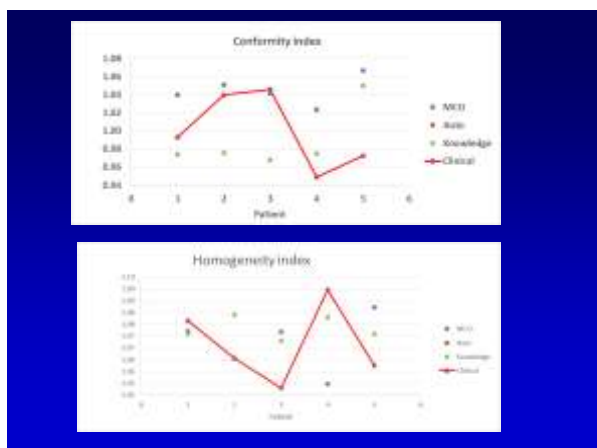


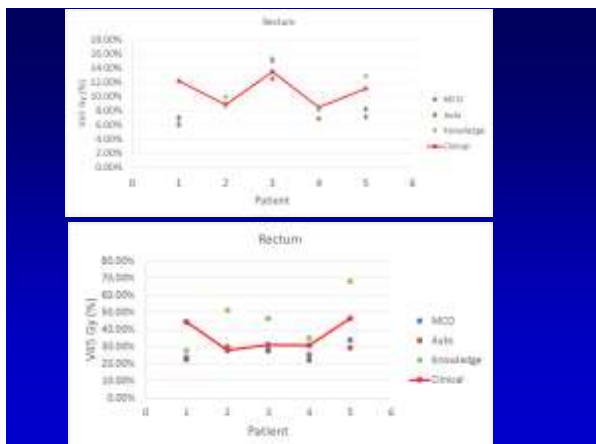


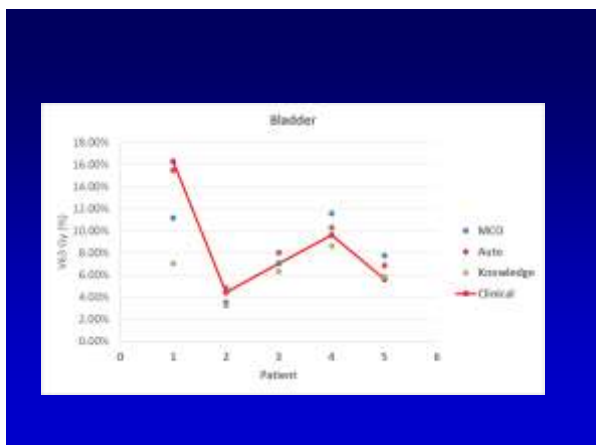


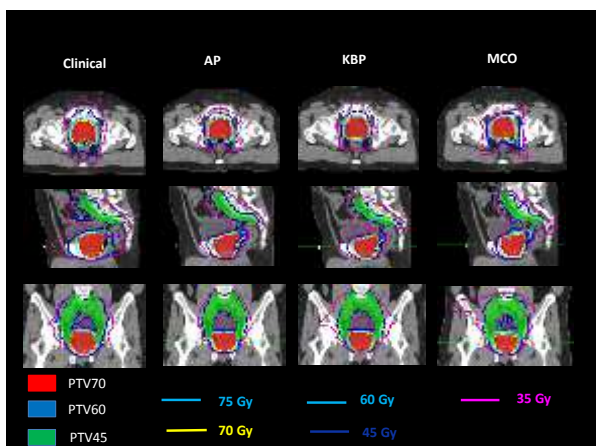


Prostate + Pelvic LN Cases

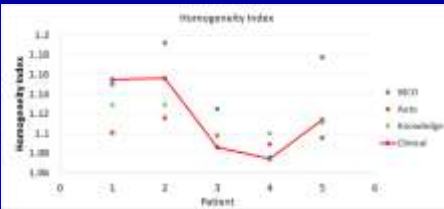
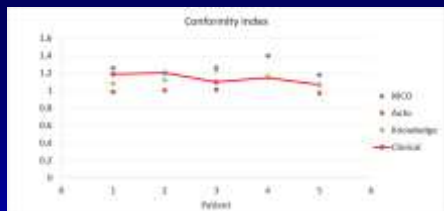


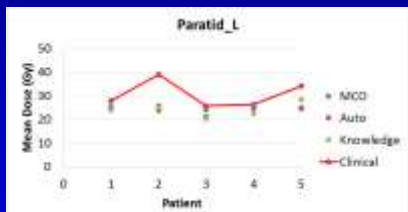
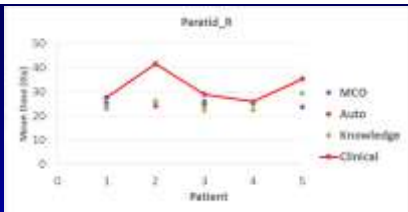


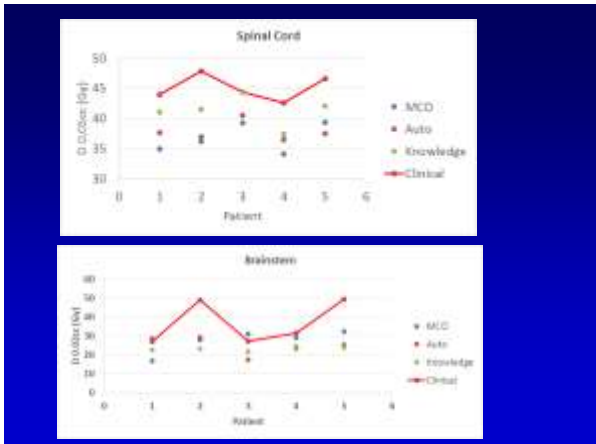


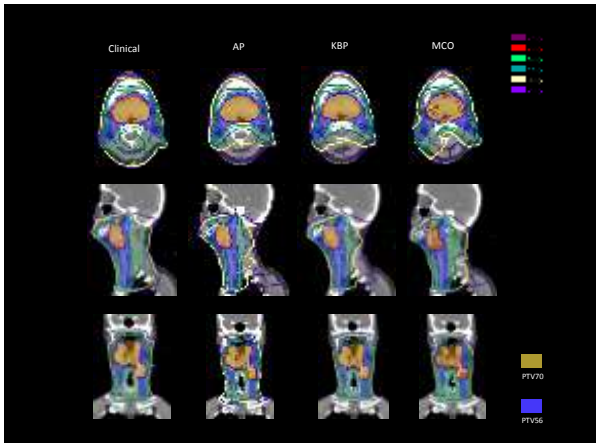


Oropharynx Cases

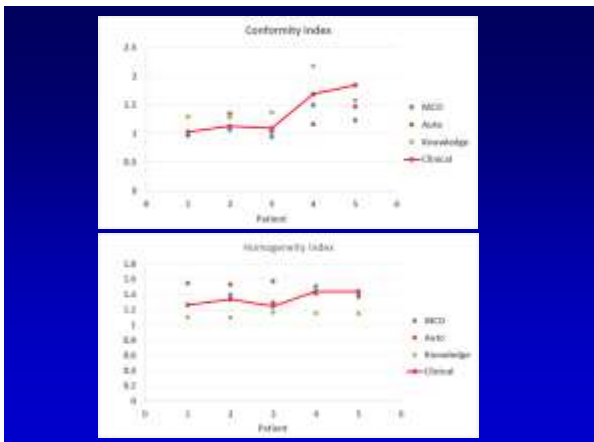


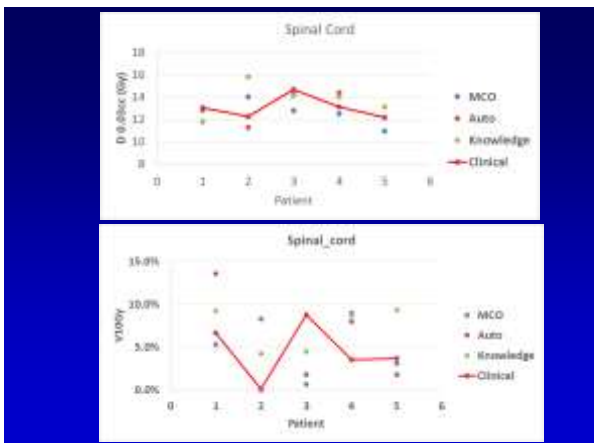


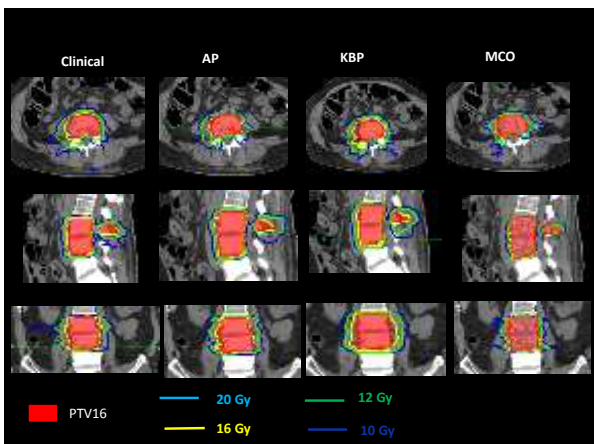


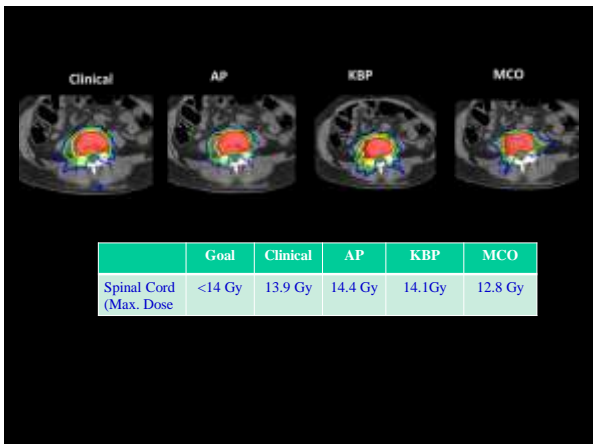


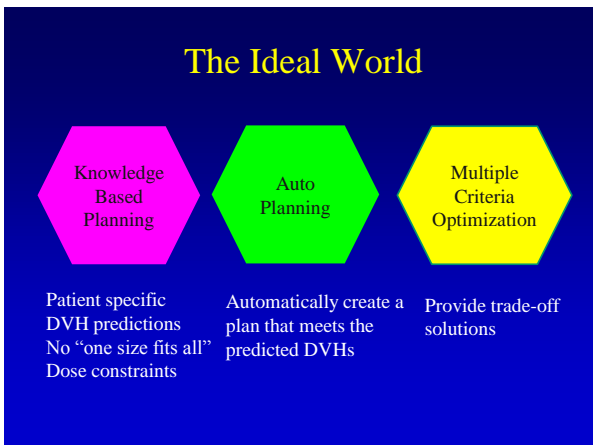
Spinal SBRT Cases











Summary

- Using advanced planning tools can further improve plan qualities and efficiency while reducing variations.
- Even with these advance planning tools, clinical judgment and experience are still important.
- We still did not find the "Pareto frontier", due to that the clinical problems cannot be clearly defined.

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