Session: Optimizing the Treatment Planning Process

Assure the quality of treatment planning when time is constrained

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Outlines

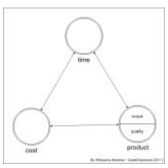
1. Introduction
2. Lean Thinking
3. Just-in-time treatment planning process
4. Find the Right People
5. Scope Reduction
6. Conclusions

Introduction

Time-Constraint Cases in RT

- Time constraint: planning time < 2 days
- Cases might include:
  - SRS/SBRT using complex IMRT/3D plans
  - Chemo RT: must start at the same time as chemo
  - Emergency palliation using simple 3D plans

Project Management Triangle



Cost: no. of planners (1)
Time: no. of days (<2)
Product: plans with specified scope and required quality

Project Constraints

- Cannot get them all: one has to suffer so that the other two can be optimized
- For the same *Scope,*
  Quality = Time × Resources
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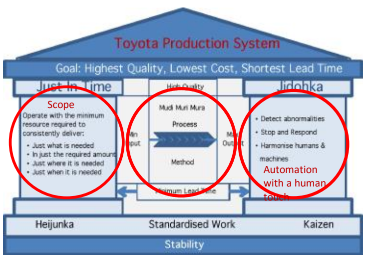
  Scope = Time × Resources
- The values are not unbounded: "one planer can finish one plan in one day" doesn't mean "Four planners can finish a plan in a quarter day.

Lean Thinking

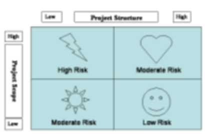
Solution: a lean process



The scope must be reduced and the process be highly structured

- Highest quality
  Scope = Time × Resources
- Time is constrained: 1-2 days
- Resource is fixed: one planner

Project Implementation Risk Matrix



Build a lean process for time-constrained cases requires

- Continuous improvement
  - Eliminate waste: inventory
  - Level production
  - Just in time
  - Standardization
- Respect for people
  - Proper training
  - Right mentality

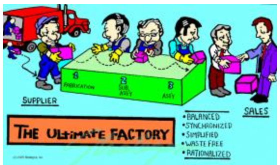
http://missiontps.blogspot.com/p/3ms.html

We need to level the fluctuation of plan production to avoid wastes and maintain quality

- Minimize the scope of the plan.
- Optimize and shorten the changeover procedures of a planner to produce a variety of plans.
- Backup planning resources
- Goals:
  - Do not overburden a planner
  - Stable output (a slow turtle is better than a fast rabbit)

Just-in-time treatment planning process

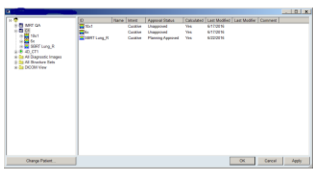
Just in Time-The Pull System to minimize inventory



In treatment planning, we don't have physical but intellectual inventory

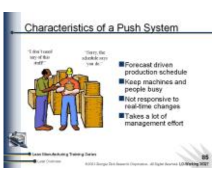
For each case, we tend to produce multiple plans (or trials) using

- Different beam arrangements
- Various constraints
- Assorted combination of energies
- Different optimization parameters
- …



Radiation oncologists must "pull" the plan they want, instead of picking a plan from many pushed to them.

- MDs must provide clear directives on what they want
- Planners only produce the plans that exactly match the requirements
- Standardization:
  - Beam arrangement
  - Energy
  - Constraints
  - Evaluation criteria



RT is a production line but mass production doesn't work in most places

- Mass production model
  - Every site/planning system is responsible by a group of planners
  - Hypothesis: A planner in this group is an expert for this site and should maximize the productivity
  - Problems:
    - Waste when demand fluctuates
    - Tend to over produce and create inventory
- Lean model:
  - Every planner should be able to plan every site using any treatment planning system
  - Plan according to established directives
  - Difficult plans not always done by the best planners but
  - There is an expert planner for each site to help

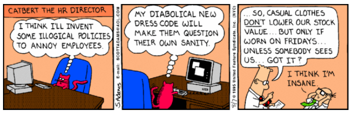
The planner and MD need to avoid incremental improvements because

- It creates wastes: takes longer to optimize than consider all constraints from the beginning
- The quality will suffer:
  - Easy to make mistakes when changing the constraints on the fly
  - Less time for plan checking

The Balancing Act of Scope Creep

Yes, we all joke about P&P but the reality is that… we need them to

- Run the TP operation fairly, effectively and efficiently
- Deal with many users, each with different personality and individual need.
- Be prepared when there is an emergency.
- Say NO to people with unreasonable requests.



Find the Right People

To deal with time-constraint cases, the planner must have the right mentality

- Keep cool under stress
- Trust other colleagues in the process
- Willing to ask help when necessary
- Not a perfectionist

We don't need anther hero – the planner must be willing to ask for help when necessary

Instead, we need team work to finish the plan in time…

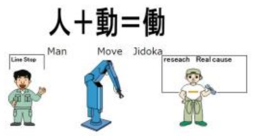
Forget about the perfect plan, get a reasonably good plan first

- A perfect plan usually
  - Takes forever to achieve or might not even exist
  - Can be undeliverable (e.g., too many modulations)
  - Requires longer setup and delivery time
  - Doesn't make a significant difference clinically
- Instead, try to get a reasonably good plan
  - Quickly
  - Simple
  - Meets most, if not all constraints

Is a perfect plan necessary?

The planner needs to

- Understand the computer does most of the planning job and
- The planner mainly plays the supervising role but
- Must know the limitations of the machine and
- Can correct problems at the earliest warning



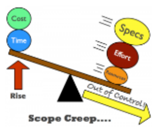
The planner also needs to be equipped wit mixed skills:

- Capable of planning multiple sites: doesn’t have to be the “go-to” person for a specific site
- Fluent with the multiple planning systems
- Able to multi-task

Scope Reduction

Can the scope of the plan be reduced?

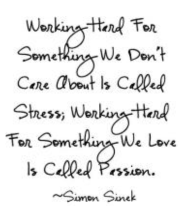
- SRS/SBRT: yes
  - Palliative IMRT or 3D plans
  - Hypofractionation
  - Ablative dose for each fraction
  - Target is usually small
- Chemo RT: not much
  - Curative IMRT plans using multiple beams
  - The plan is generally complicated with large PTV
  - Conventional fraction allows partial scope reduction.
- Emergency palliation: not needed since the plan is already very simple.



Partial scope reduction

1. Start with a simple 3D plan for the first few fractions so that
2. We can buy time to do an IMRT/VMAT plan for the remaining.
3. Constraints for the IMRT/VMAT plan need to be relaxed due to the contribution of the 3D plan.

Sometime we simply have to bite the bullet and get the plan done in time. We do it for the patients.



Reduce the scope for SRS/SBRT plans

- Conformality index?
- Technique: 3D or IMRT?
- No. of beams/arcs?
- Single isocenter vs. multiple isocenters
- FFF beams or not?

Don't kill yourself driving down the conformity index (CI) for 3D plans

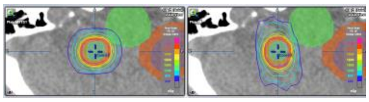
- CI>2 is bad
- In most cases, it is relatively easy to make CI <1.6, and possibly <1.4 but
- You might need a few more hours to drive CI < 1.2
- Suggestions: when time is constrained
  - Do not spend too much additional time once CI < 1.6, particularly when the deadline is approaching
  - If CI is really important (e.g., involving optical structures for curative plans), use IMRT

Which technique one is better?

- 3D
  - Static
  - Conformal arc
  - Circular arc
  - Dynamic arc (DARC)
- IMRT
  - Step-and-shoot (STSH)
  - Sliding window (SLWD)
  - VMAT/rapid arc

For 3D, the plan quality is generally similar

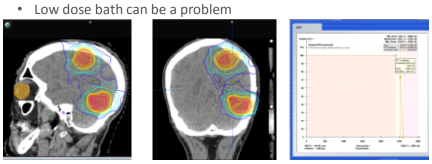
- Arc beams take the least amount of time for planning and delivery
- Static beams have an advantage while trying to avoid OARs.
- Conformity index is not an issue except for targets with a very irregular shape



Arcs | Static beams

IMRT plans can achieve better dose conformity and uniformity but

- Take longer to plan, check and delivery
- Will require IMRT QA
- Not easy to produce traditional SRS non-uniform (e.g., max 125%) dose distribution
- Low dose bath can be a problem

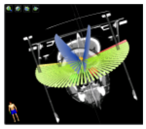


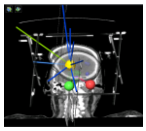
Technique Selection for SRS/SBRT

- IMRT
  - If the target is irregularly shaped or
  - Dose uniformity is a concern (e.g., dmax <110%).
  - Try VMAT/RapidArc first for faster delivery
  - Use STSH or SLWD for potentially better OAR sparing
- 3D
  - If the target is regularly shaped (e.g., spherical) and
  - Higher dose maxima allowed.
  - Use static beams if PTV is close to OARs
  - Otherwise, use DARC

Reports recommend 5 arcs or 15 static beams for brain SRS/SBRT, but

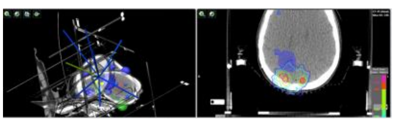
- For brain SRS, it might be sufficient using
  - 3 couch angles with
  - 3 dynamic/conformal arcs or
  - 10 static/IMRT beams.
- For brain SBRT
  - 2 (e.g., 0 and 90) couch angles with
  - 2 VMAT/RapdiArc beams or
  - 7-8 IMRT beams.





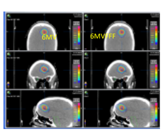
Single isocenter for multiple targets saves planning and delivery time

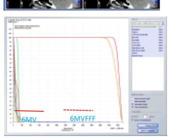
- Not limited to VMAT/RapidArc
- Can also be used for STSH, SLWD, DARC, static beams…
- Potential additional setup error due to rotation
- Use slightly larger PTV margin if necessary



FFF beams will speed up the delivery for SRS/SBRT

- The target is generally small: you can get a good plan with either FFF or traditional beams
- The delivery is faster for a SRS/SBRT plan using FFF beams.
- FFF is great for SRS that requires non-uniform dose distribution within PTV





Conclusions

- Time-constraint cases are manageable.
- Implement a just-in-time planning process:
  - Avoid convoluted process and incremental improvement
  - Level the production
  - Reduce the scope
- Find the right planners
  - With the right mentality
  - Can keep cool under stress
  - Is able to multi-task
- Standardization
  - Algorithm for choosing the planning approach
  - Clear acceptance and rejection criteria
  - Written P&P and/or directives