Associazione Italiana Radioterapia e Oncologia clinica

Società Italiana di Radiobiologia

LA QUALITÀ DI UN PIANO DI CURA IN RADIOTERAPIA STEREOTASSICA

Il punto di vista del fisico medico

UNIVERSITÀ DEGLI STUDI FIRENZE
DIPARTIMENTO DI SCIENZE BIOMEDICHE SPERIMENTALI E CLINICHE

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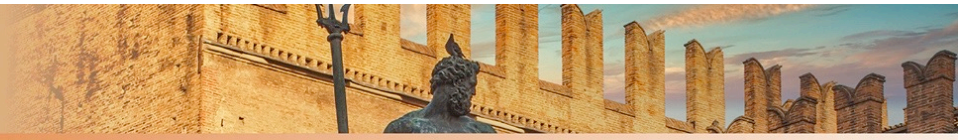
Associazione Italiana Radioterapia e Oncologia clinica
Società Italiana di Radiobiologia



DICHIARAZIONE

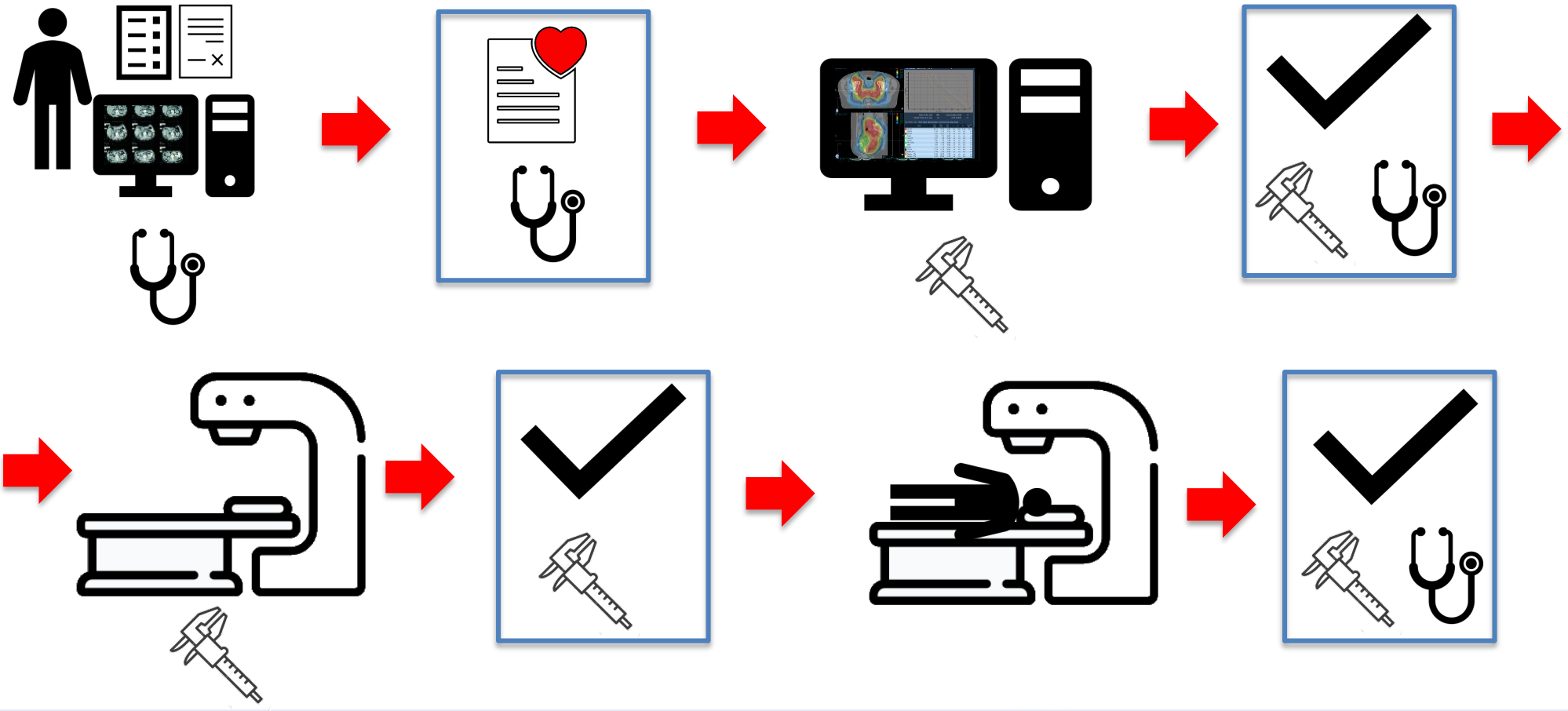
Relatore: Stefania Pallotta

Come da nuova regolamentazione della Commissione Nazionale per la Formazione Continua del Ministero della Salute, è richiesta la trasparenza delle fonti di finanziamento e dei rapporti con soggetti portatori di interessi commerciali in campo sanitario.

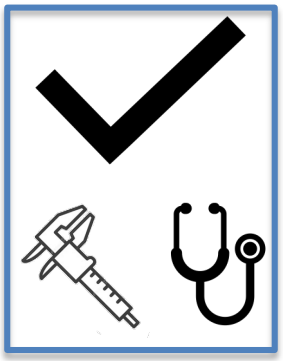
- Posizione di dipendente in aziende con interessi commerciali in campo sanitario (**NIENTE DA DICHIARARE**)
- Consulenza ad aziende con interessi commerciali in campo sanitario (**NIENTE DA DICHIARARE**)
- Fondi per la ricerca da aziende con interessi commerciali in campo sanitario (**NIENTE DA DICHIARARE**)
- Partecipazione ad Advisory Board (**NIENTE DA DICHIARARE**)
- Titolarità di brevetti in compartecipazione ad aziende con interessi commerciali in campo sanitario (**NIENTE DA DICHIARARE**)
- Partecipazioni azionarie in aziende con interessi commerciali in campo sanitario (**NIENTE DA DICHIARARE**)
- Altro

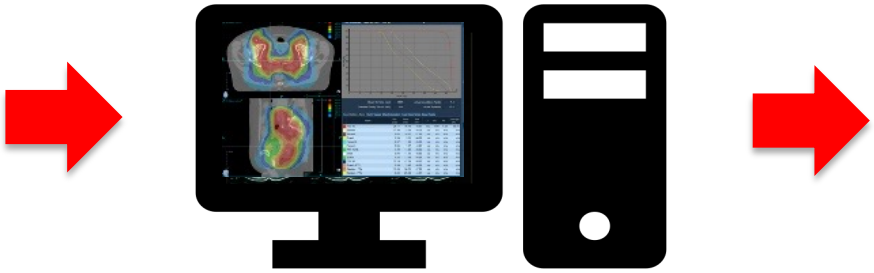
SRT → well localized targets
high Dose
few fractions

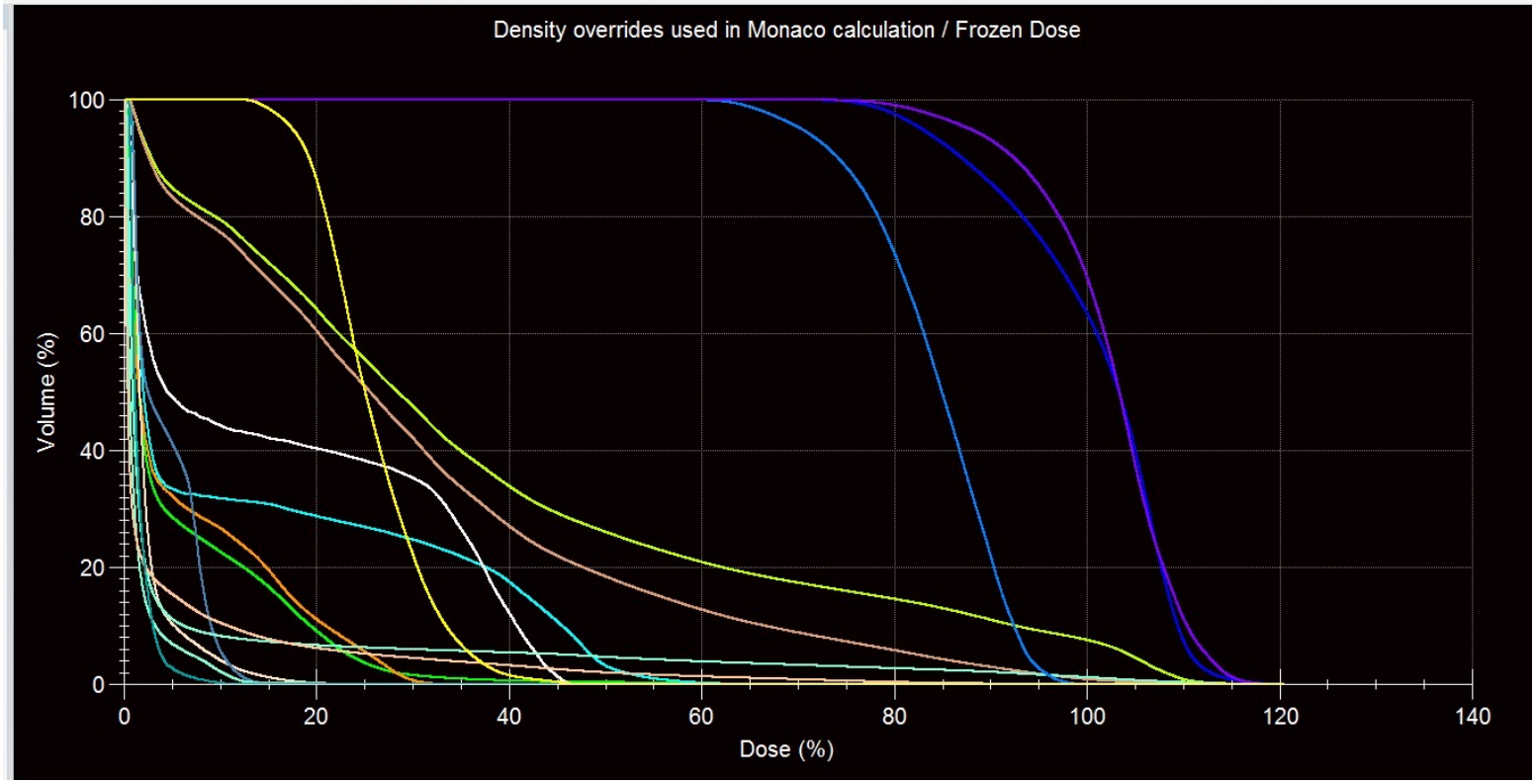
Quality = Performance - Expectations

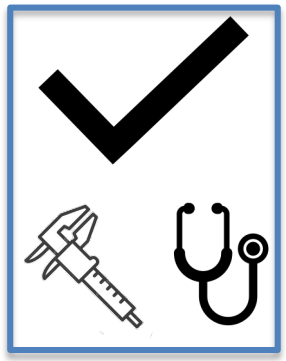


What is the quality of the planned treatment plan?

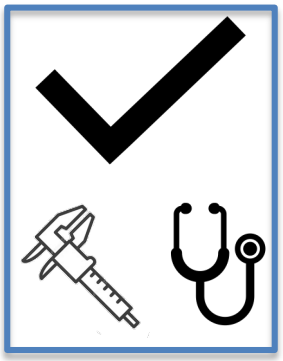





Density overrides used in Monaco calculation / Frozen Dose
Volume (%)
Dose (%)
0
20
40
60
80
100
120
140

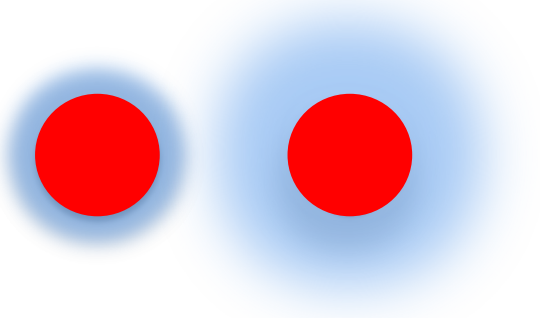


Quantitative metrics



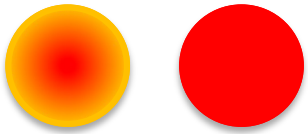
Gradient index

Dose fall-off steepness outside the target



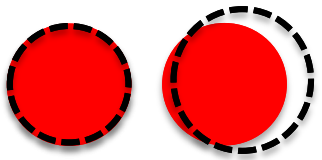
Homogeneity index

Dose homogeneity in the target



Conformity index

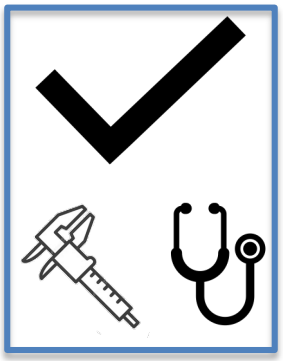
Dose conformity to the target



Homogeneity Index

$$HI_T = \frac{D_{max}}{D_{min}} \qquad HI_{RTOG} = \frac{D_{max}}{D_p}$$

Shaw, et al.. *IJROBP* 1993;27:1231–9



$$HI = \frac{D_2 - D_{98}}{D_p} x100$$

Wo, et al.. *IJROBP* 2003;26:573-85.

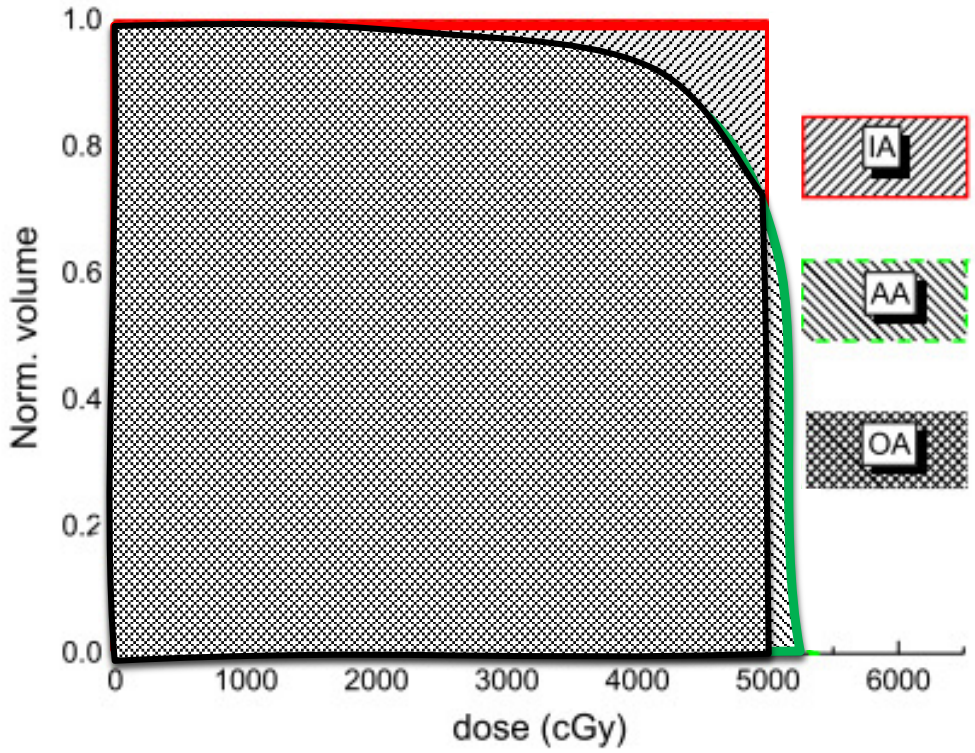
$$HI = \frac{D_5}{D_{95}}$$

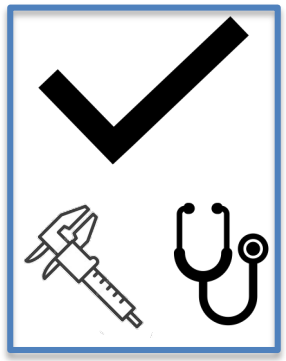
Semerenko, et al. Med Phys 2008;35:5851-60.

D_{max} = max dose in the target
D_{min}= min dose in the target
D_p = prescribed dose

D_5 = min dose in 5% of the target
D_2 = min dose in 2% of the target
D_{95} = min dose in 95% of the target
D_{98} = min dose in 98% of the target

Homogeneity Index





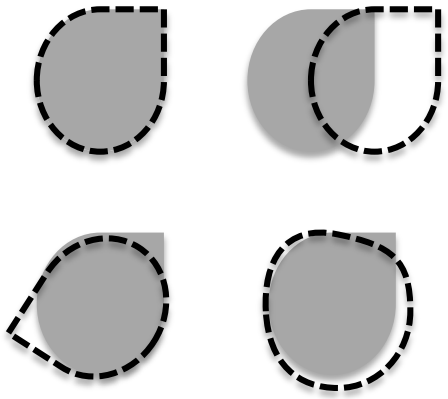
$$HI = \frac{OA^2}{IAxAA}$$

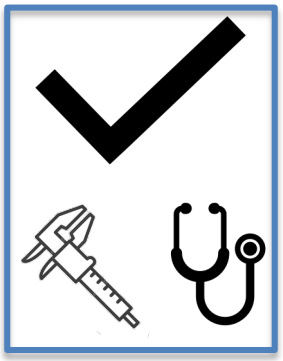
Yan, et al. J Appl Clin Med Phys 2019; 20:11:50–56

Conformity Index

$$CI_{RTOG} = \frac{PIV}{TV}$$

Shaw, et al.. *IJROBP* 1993;27:1231–9





$$CI_{Paddick} = \frac{TV_{PIV}{}^2}{TV x PIV}$$

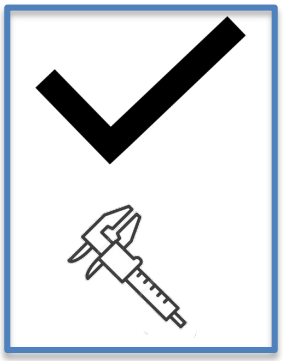
Paddick.. *J N 2000;93:219-222.*

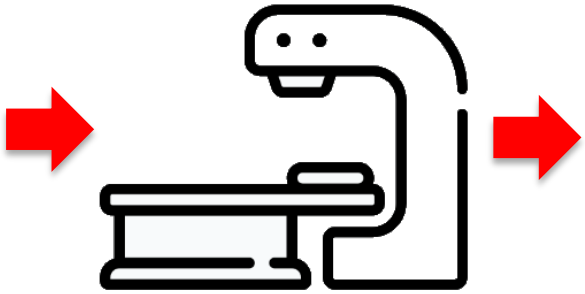
PIV = prescription isodose volume

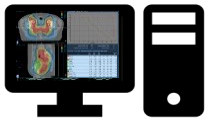
TV = target volume

TV_{PIV}= the volume of the target covered by PI

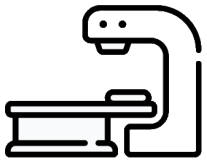
Is the planned treatment the same as the delivered?







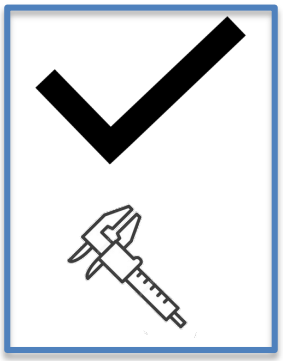
Linac beam model
Dose calculation algorithm



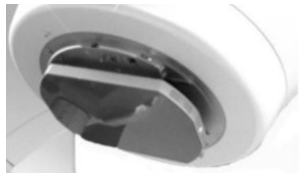
linac parameters

TPS Dose calculation accuracy
Linac calibration

e2e test

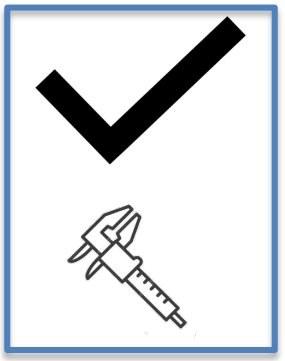


Patient Specific Quality Assurance

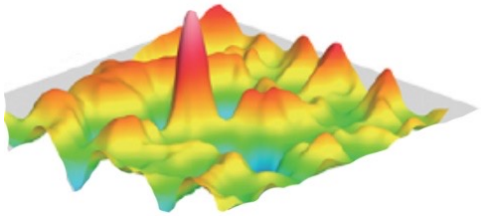


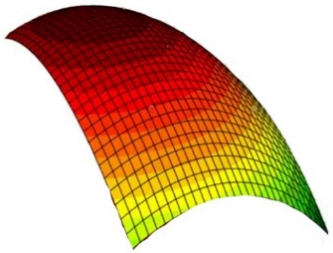
portal dosimetry

Plan complexity metrics

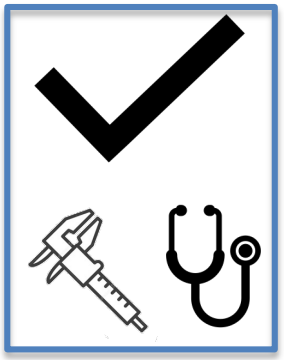


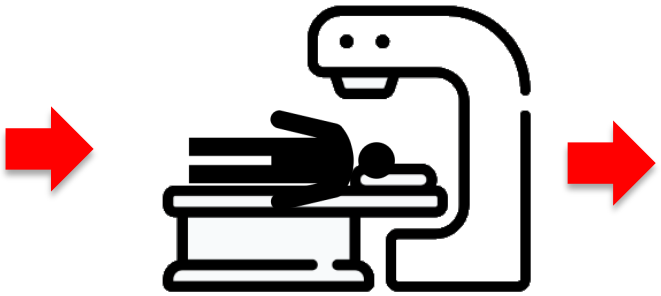
fluence





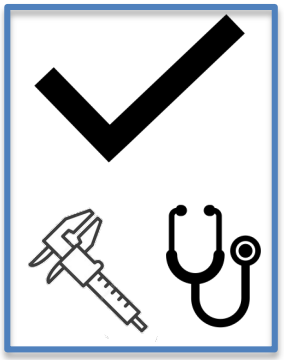
Is the planned treatment robust ?





Patient setup - Anatomical changes or movements - Density changes

Robust plan ⇨ CTV/ITV receives the prescribed dose
OARs fulfil restrictions

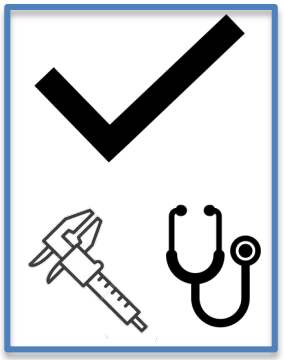


Margins approach ⇨ PTV, PRV

But the margin approach presents several limitations!

It relies on the so-called static dose cloud approximation.
It does not guarantee optimal management for PTVs extending into air.

No margins approach ⇨ Robust optimization



Instead of optimizing a single scenario, dose distributions are optimized for n possible scenarios.

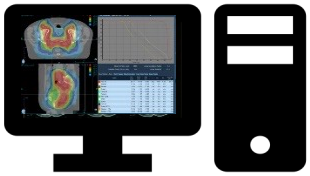
worst-case scenario
probabilistic approach

It is always possible to make an a posteriori assessment of the plan's robustness.

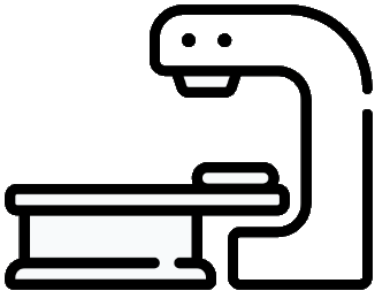
Conclusions

SRT quality depends on:

Planned plan



Plan complexity



Plan robustness