Associazione Italiana Radioterapia e Oncologia clinica

Società Italiana di Radiobiologia


XXXII CONGRESSO NAZIONALE AIRO
XXXIII CONGRESSO NAZIONALE AIRB
XII CONGRESSO NAZIONALE AIRO GIOVANI
AIRO2022
Radioterapia di precisione per un'oncologia innovativa e sostenibile
BOLOGNA, 25-27 NOVEMBRE
PALAZZO DEI CONGRESSI
Planning automatico
Christian Fiandra
AZIENDA OSPEDALIERO - UNIVERSITARIA
Città della Salute e della Scienza di Torino
DEPARTMENT OF
ONCOLOGY
UNIVERSITY OF TURIN
Associazione Italiana
Radioterapia e Oncologia clinica
Società Italiana di Radiobiologia

DICHIARAZIONE

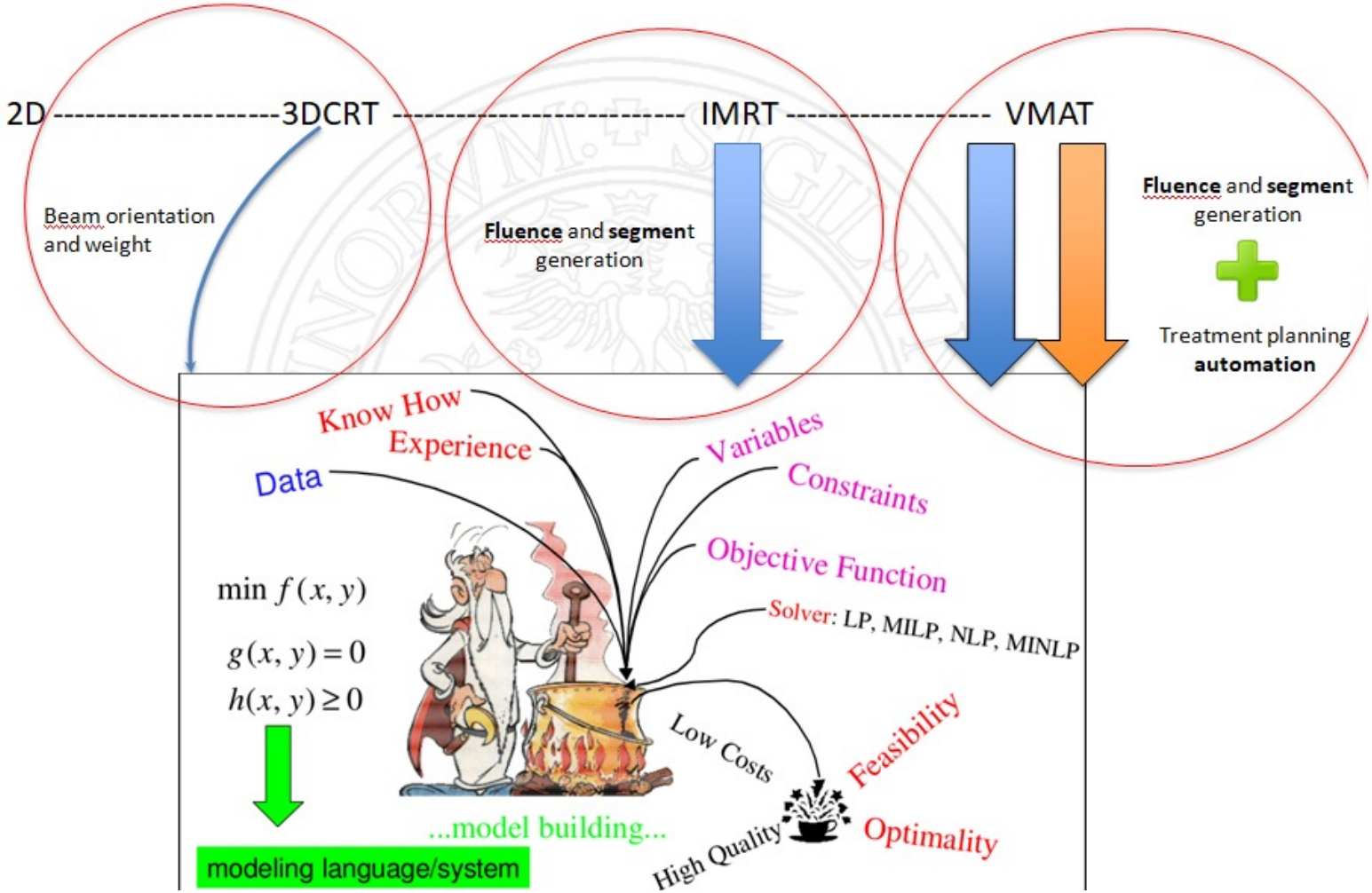
Relatore: Christian Fiandra

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

Conclusioni: Paziente di 71, affetto da carcinoma squamoso non cheratinizzante scarsamente differenziato dell'ipofaringe (a verosimile partenza dal seno piriforme sx e con estensione sovraglottica) localmente avanzato high-burdenin stadio cT4aN3b (stadio IVB con adenopatia bulky), avviato a ICT dopo discussione GIC (eseguiti 3 cicli, ultimo in data 11/03/22).Alla TC di restaging buona risposta sul T e N.
Si pone indicazione a trattamento radiante radicale.

Radiotherapy treatment planning evolution.....

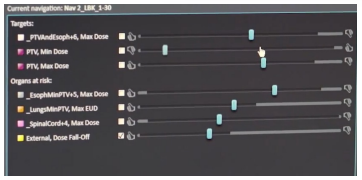


Overview

Automation in Radiotherapy Planning

RayStation

MCO

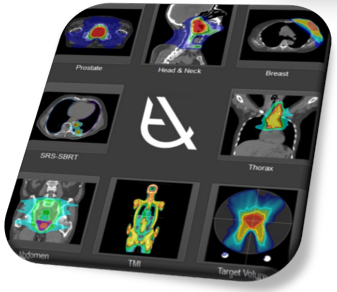


VARIAN
medical systems

PHILIPS

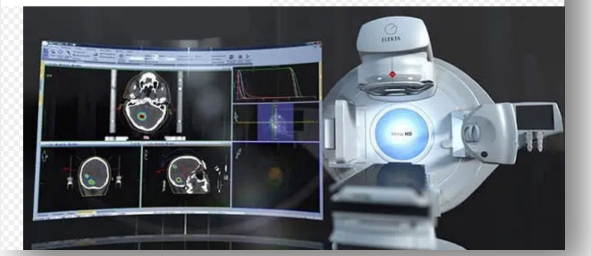
Pinnacle³

Pinnacle³ Auto-Planning

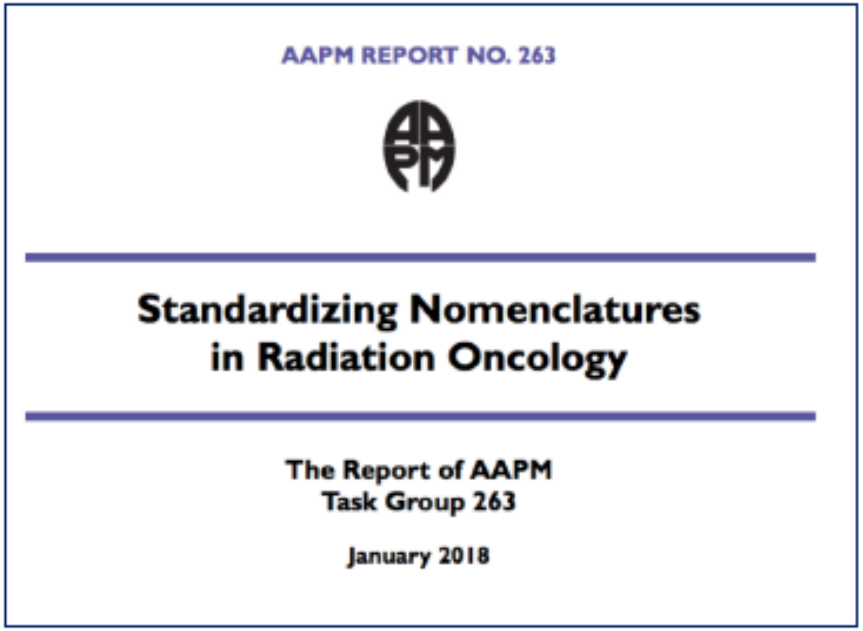


Guided Planning Solution

Elekta IntelliPLAN



Treatment planning automation


AAPM REPORT NO. 263

Standardizing Nomenclatures in Radiation Oncology

The Report of AAPM Task Group 263

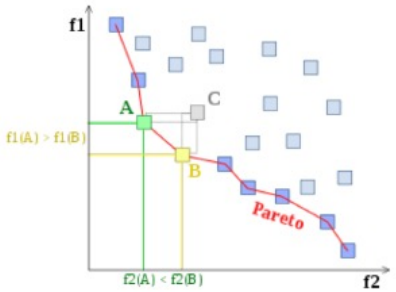
January 2018

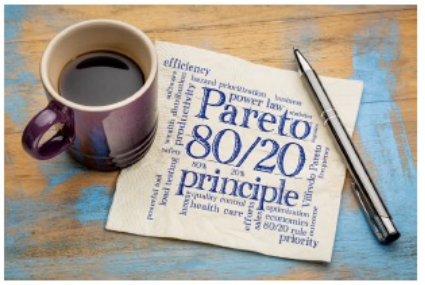
Standardization is key to improve script-based plan evaluation

Reduce variability and inconsistencies

Treatment planning automation

MultiCriteria Optimization





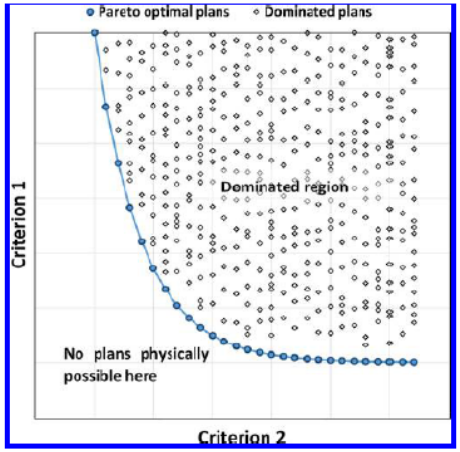
Key concept: PARETO OPTIMAL SOLUTION

A plan that cannot be improved in any of the objectives without degrading at least one of the other objectives

Treatment planning automation

a posteriori MCO approach

- Multiple plans are automatically generated where each criterion is optimised to the extent where it cannot be improved upon without affecting at least one other criterion; each of these plans is a so-called pareto optimal solution



(Hussein, BJR 2018)

Treatment planning automation

a priori MCO approach: a single pareto-optimal plan

- Planner sets up in advance a set of goals, related to clinical prescriptions, that are ordered with respect to importance (whish list).
- Lexicographic Optimization is performed as a *stepwise sequence* of constrained optimizations, starting with the highest prioritized objective function.
- At each iterative step, a new objective function from the list is optimized with the previous goals incorporated as constraints so that the higher prioritized goals are not deteriorated.

Treatment planning automation

a priori MCO approach: The Rotterdam Experience

IOP Publishing — Physics in Medicine and Biology
Phys. Med. Biol. **54** (2009) 7199–7209 doi:10.1088/0031-9155/54/23/011

The equivalence of multi-criteria methods for radiotherapy plan optimization

Sebastiaan Breedveld, Pascal R M Storchi and Ben J M Heijmen

Department of Radiation Oncology, Erasmus MC Rotterdam, Groene Hilledijk 301, 3075 EA Rotterdam, The Netherlands

Erasmus MC
Universitair Medisch Centrum Rotterdam

International Journal of Radiation Oncology biology • physics
www.redjournal.org

Physics Contribution

Toward Fully Automated Multicriterial Plan Generation: A Prospective Clinical Study

Peter W.J. Voet, RTT, Maarten L.P. Dirkx, PhD, Sebastiaan Breedveld, MSc, Dennie Fransen, RTT, Peter C. Levendag, MD, PhD, and Ben J.M. Heijmen, PhD

Department of Radiation Oncology, Erasmus Medical Center—Daniel den Hoed Cancer Center, Groene Hilledijk 301, Rotterdam 3075EA, The Netherlands

Received Jan 24, 2012, and in revised form Mar 27, 2012. Accepted for publication Apr 10, 2012

Integrated multicriterial optimization of beam angles and intensity profiles for coplanar and noncoplanar head and neck IMRT and implications for VMAT

Peter W. J. Voet,[a)] Sebastiaan Breedveld, Maarten L. P. Dirkx, Peter C. Levendag, and Ben J. M. Heijmen

Erasmus MC–Daniel den Hoed Cancer Center, Department of Radiation Oncology, Groene Hilledijk 301, 3075EA Rotterdam, The Netherlands

Erasmus MC
Universitair Medisch Centrum Rotterdam

International Journal of Radiation Oncology biology • physics
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Physics Contribution

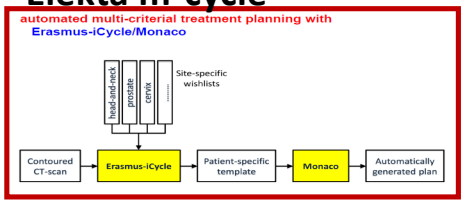
Fully Automated Volumetric Modulated Arc Therapy Plan Generation for Prostate Cancer Patients

Peter W.J. Voet, RTT, Maarten L.P. Dirkx, PhD, Sebastiaan Breedveld, PhD, Abrahim Al-Mamgani, MD, PhD, Luca Incrocci, MD, PhD, and Ben J.M. Heijmen, PhD

Department of Radiation Oncology, Erasmus MC—Daniel den Hoed Cancer Center, Rotterdam, The Netherlands

Received Sep 19, 2013, and in revised form Dec 10, 2013. Accepted for publication Dec 28, 2013.

Elekta m-cycle



Prostate wishlist

Constraints

Volume	Type	Limit
PTV	max	104% of prescribed dose
PTV shell 50 mm	max	60% of prescribed dose
Unspecified tissue	max	104% of prescribed dose
Right + Left hip	max	40 Gy

Objectives

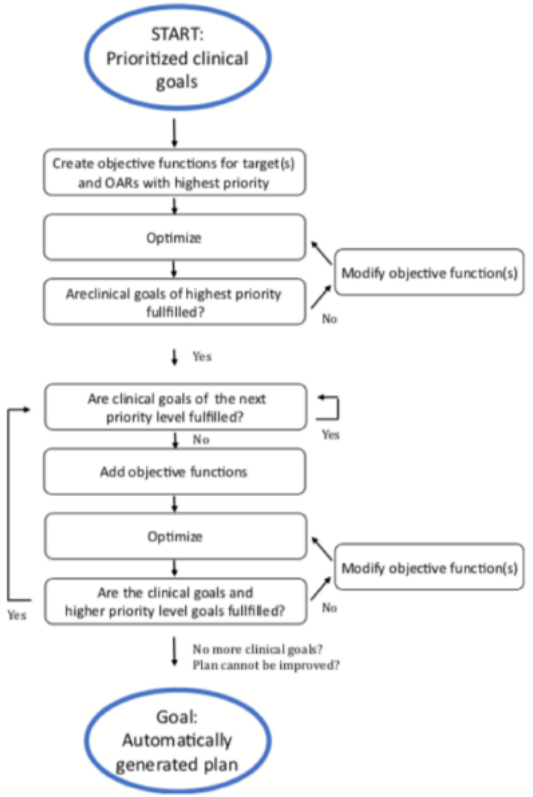
Priority	Volume	Type	Goal
1	PTV	↓LTCP	0.5
2	Rectum	↓gEUD (parameter 12)	40% of prescribed dose
3	Rectum	↓gEUD (parameter 8)	25% of prescribed dose
4	Rectum	↓mean	33% of prescribed dose
5	External ring	↓max	40% of prescribed dose
6	PTV shell 5 mm	↓max	93% of prescribed dose
7	Anus	↓mean	10% of prescribed dose
8	PTV shell 15 mm	↓max	70% of prescribed dose
9	PTV shell 25 mm	↓max	50% of prescribed dose
10	Bladder	↓mean	60% of prescribed dose
11	Right + Left Hip	↓mean	25% of prescribed dose
12	Unspecified tissue	↓mean	10 Gy

Treatment planning automation

Lexicographic optimization

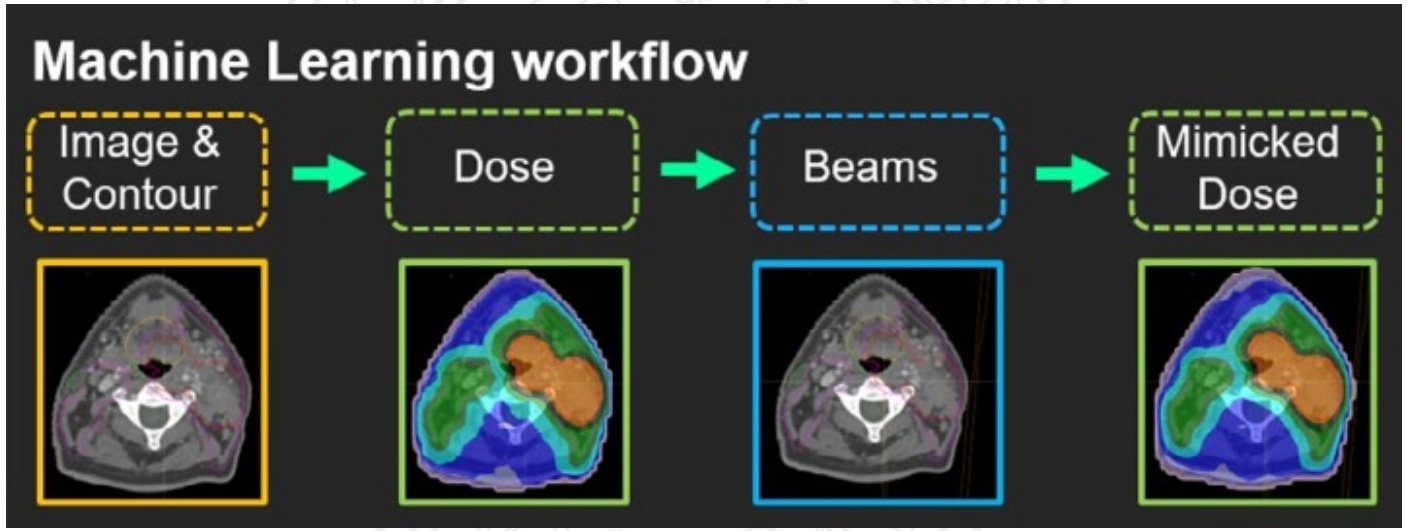
RayStation Plan Explorer

A set of clinical goals are listed and ordered in terms of importance, where several goals can have the same priority level.
Objective functions that correspond to the clinical goals for the ROIs considered at the current priority level are automatically created by the algorithm, and their priority weights and dose levels are modified iteratively until the optimized plan fulfils the clinical goals stated for them. For each group of goals, objective functions are automatically added and modified with the aim of fulfilling the clinical goals without violating the levels achieved for the previous (higher prioritized) goals. *This automatic process can be performed for different beam configurations, other treatment machines, treatment techniques and modalities*



Treatment planning automation

RayStation machine learning dose mimicking



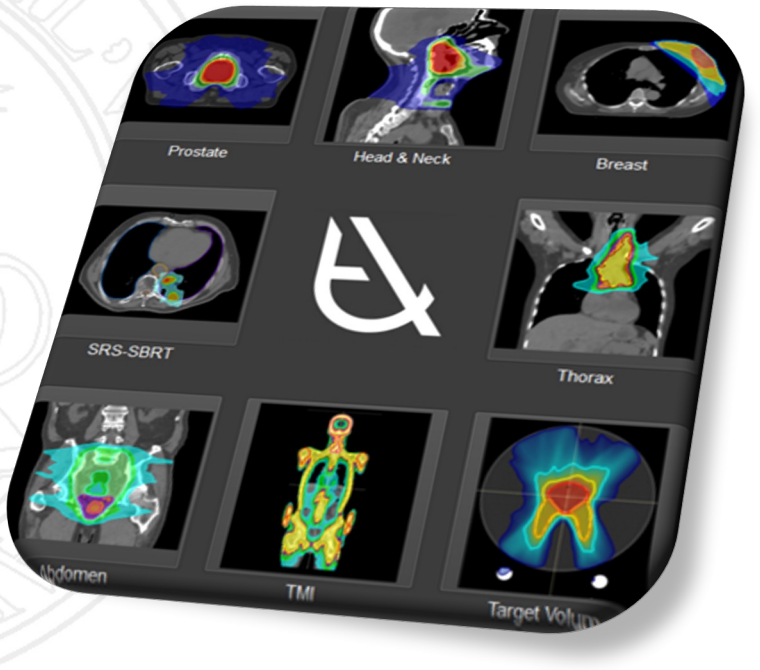
GPS 4.1

UNIVERSITÀ DEGLI STUDI DI TORINO

Erasmus MC
Universitair Medisch Centrum Rotterdam

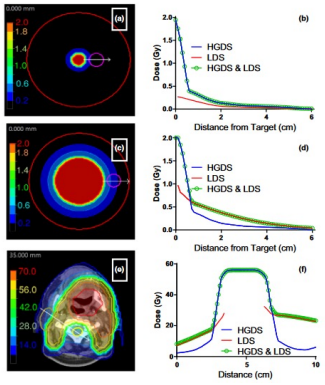
POLITECNICO DI TORINO

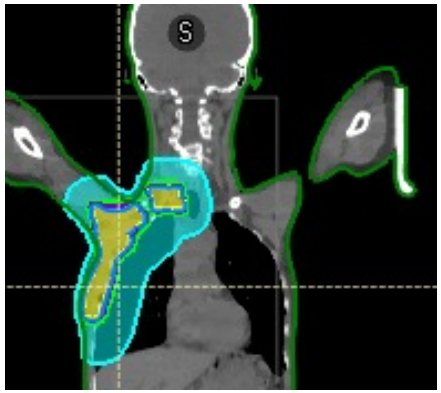
TECNOLOGIE AVANZATE



GPS 4.1

Benchmark dose





A method for *a priori* estimation of best feasible DVH for organs-at-risk: Validation for head and neck VMAT planning

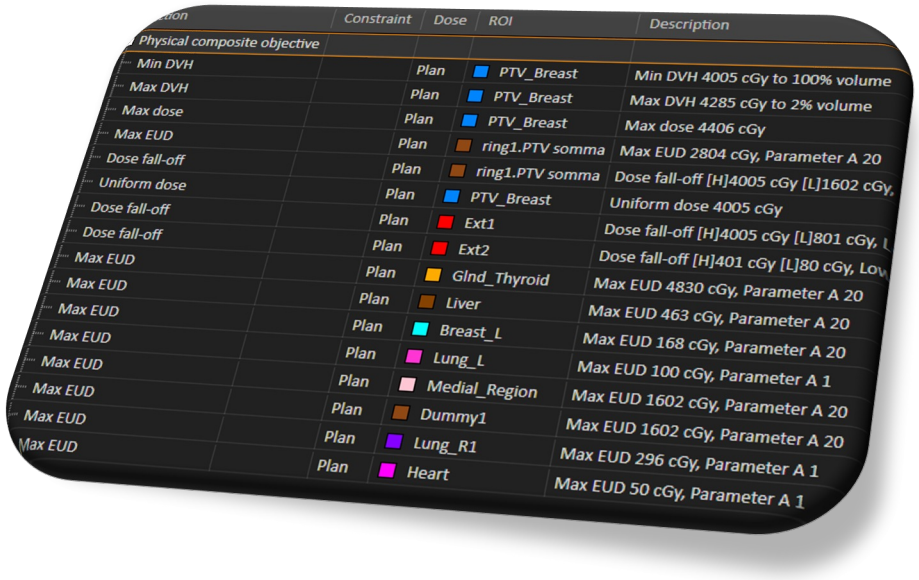
Saeed Ahmed
Department of Physics, University of South Florida, Tampa, FL 33612, USA

Benjamin Nelms
Canis Lupus LLC, Merrimac, WI 53561, USA

Dawn Gintz, Jimmy Caudell, Geoffrey Zhang, Eduardo G. Moros, and Vladimir Feygelman[a)]
Department of Radiation Oncology, Moffitt Cancer Center, Tampa, FL 33612, USA

(Received 27 March 2017; revised 24 July 2017; accepted for publication 24 July 2017; published 31 August 2017)

Patient specific optimization function

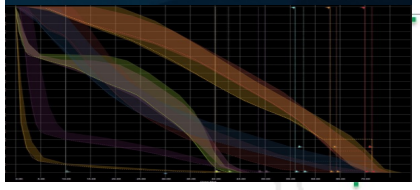


	Constraint	Dose	ROI	Description
Physical composite objective				
Min DVH		Plan	PTV_Breast	Min DVH 4005 cGy to 100% volume
Max DVH		Plan	PTV_Breast	Max DVH 4285 cGy to 2% volume
Max dose		Plan	PTV_Breast	Max dose 4406 cGy
Max EUD		Plan	ring1.PTV somma	Max EUD 2804 cGy, Parameter A 20
Dose fall-off		Plan	ring1.PTV somma	Dose fall-off [H]4005 cGy [L]1602 cGy,
Uniform dose		Plan	PTV_Breast	Uniform dose 4005 cGy
Dose fall-off		Plan	Ext1	Dose fall-off [H]4005 cGy [L]801 cGy, L
Dose fall-off		Plan	Ext2	Dose fall-off [H]401 cGy [L]80 cGy, Lo
Max EUD		Plan	Glnd_Thyroid	Max EUD 4830 cGy, Parameter A 20
Max EUD		Plan	Liver	Max EUD 463 cGy, Parameter A 20
Max EUD		Plan	Breast_L	Max EUD 168 cGy, Parameter A 20
Max EUD		Plan	Lung_L	Max EUD 100 cGy, Parameter A 1
Max EUD		Plan	Medial_Region	Max EUD 1602 cGy, Parameter A 20
Max EUD		Plan	Dummy1	Max EUD 1602 cGy, Parameter A 20
Max EUD		Plan	Lung_R1	Max EUD 296 cGy, Parameter A 1
		Plan	Heart	Max EUD 50 cGy, Parameter A 1

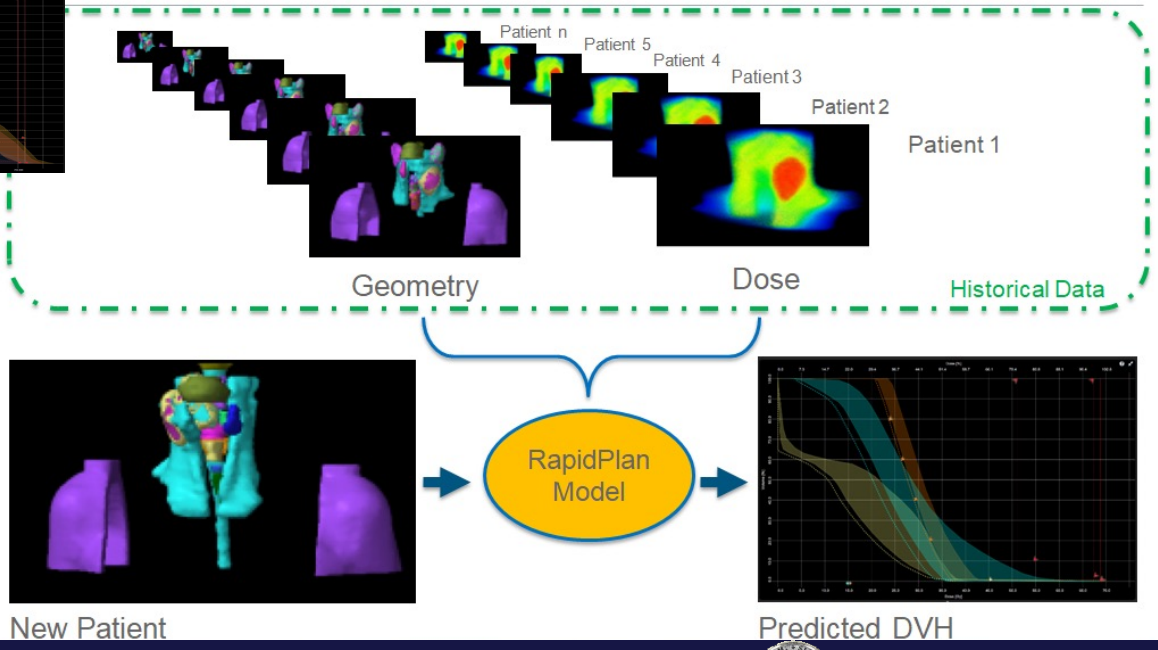
Treatment planning automation

VARIAN
medical systems

THE SOLUTION
RapidPlan™



A knowledge-based planning (KBP)



Treatment planning automation

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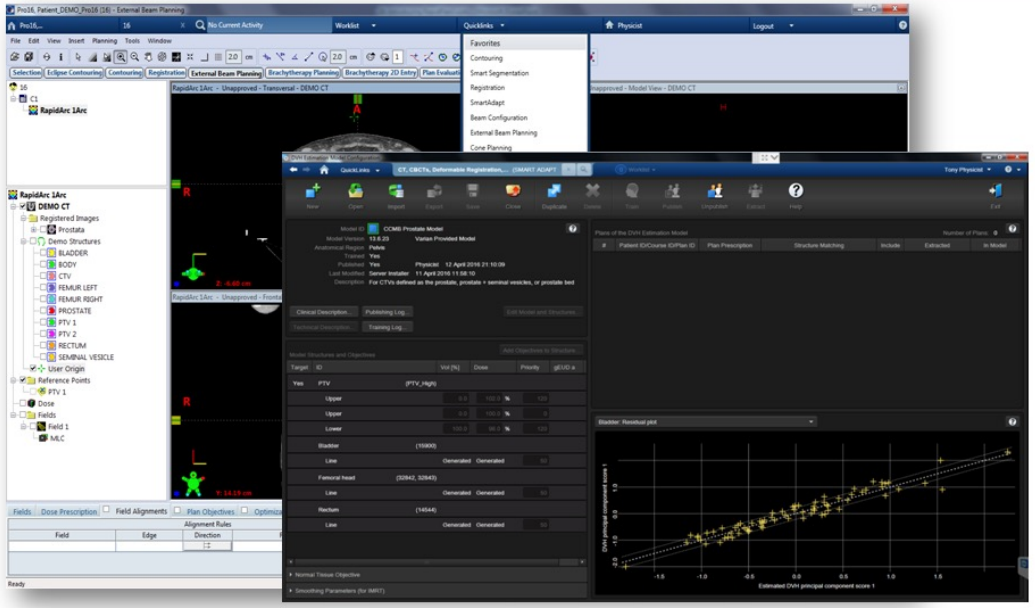
DVH Estimation Model Workspace



Treatment planning automation

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medical systems

- Define goals and scope
- Create a new model
- Attach a set of plans
- Train and fine tune
- Validate and Publish

Build Your Knowledge

Treatment planning automation

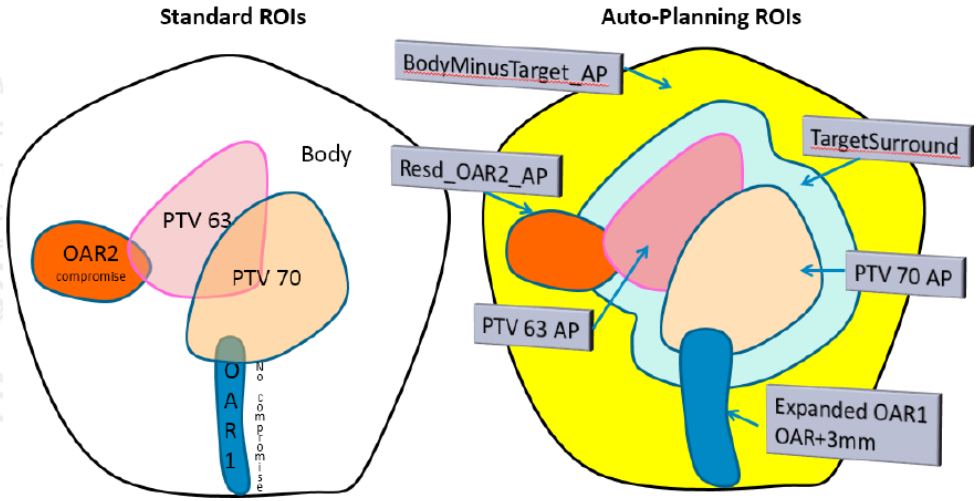
PHILIPS

Pinnacle³

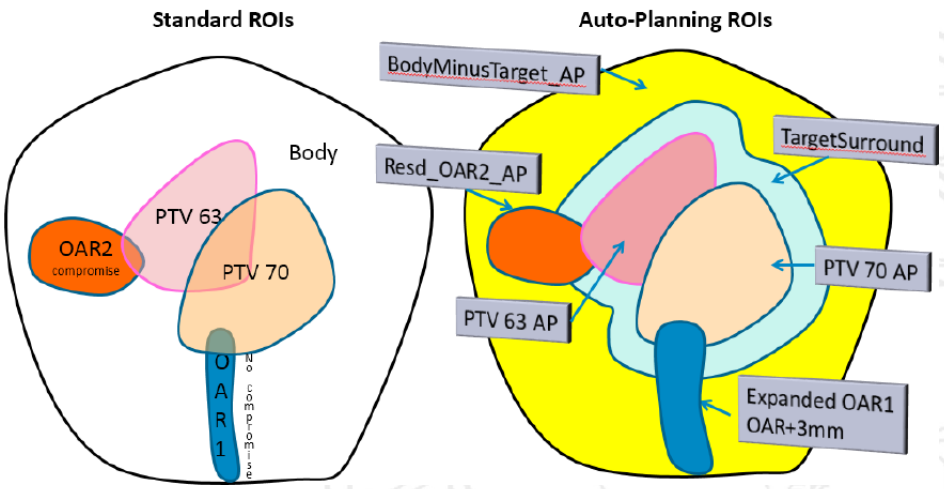
Pinnacle³ Auto-Planning

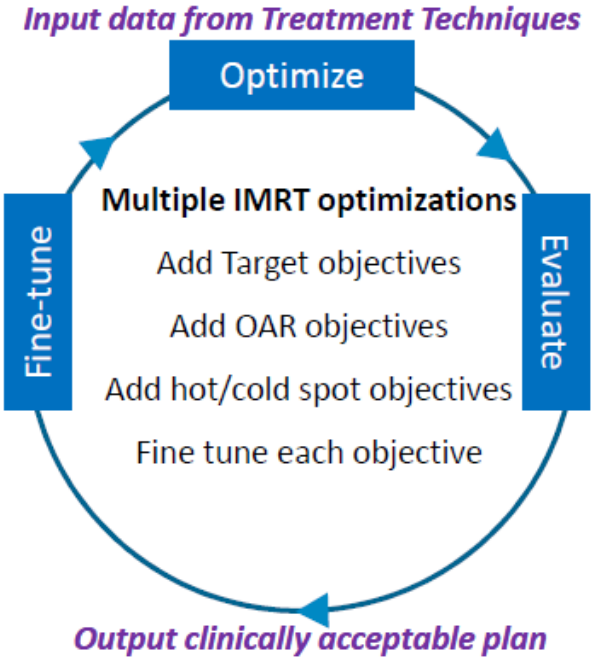
Progressive Optimization Algorithm POA

Auto-Planning ROIs



Auto-Planning ROIs





Loop1: Resets the beams. Add **Target Objectives**. Opti

Loop2: Add **OAR Objectives**. Optimize.

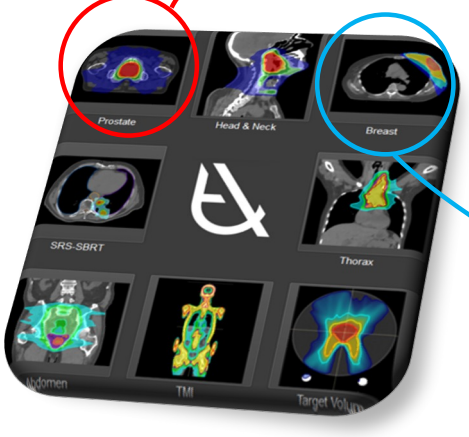
Loop3: **Tune** OAR Objectives. Optimize

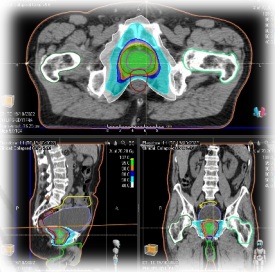
Loop4: Reset the Beams. Tune/Add OAR Objectives**. Hot/Cold spot objectives**. Optimize.

Loop5: Tune/Add OAR Objectives, Hot/Cold spot objectives. Optimize.

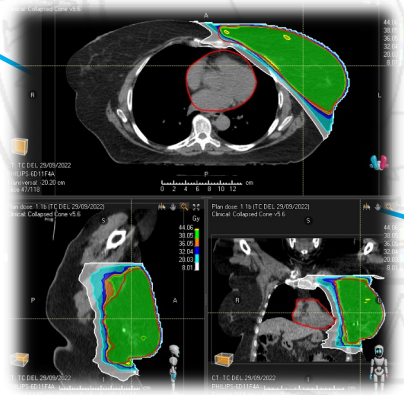
Large Italian multicentric studies with GPS

GPS 4.1



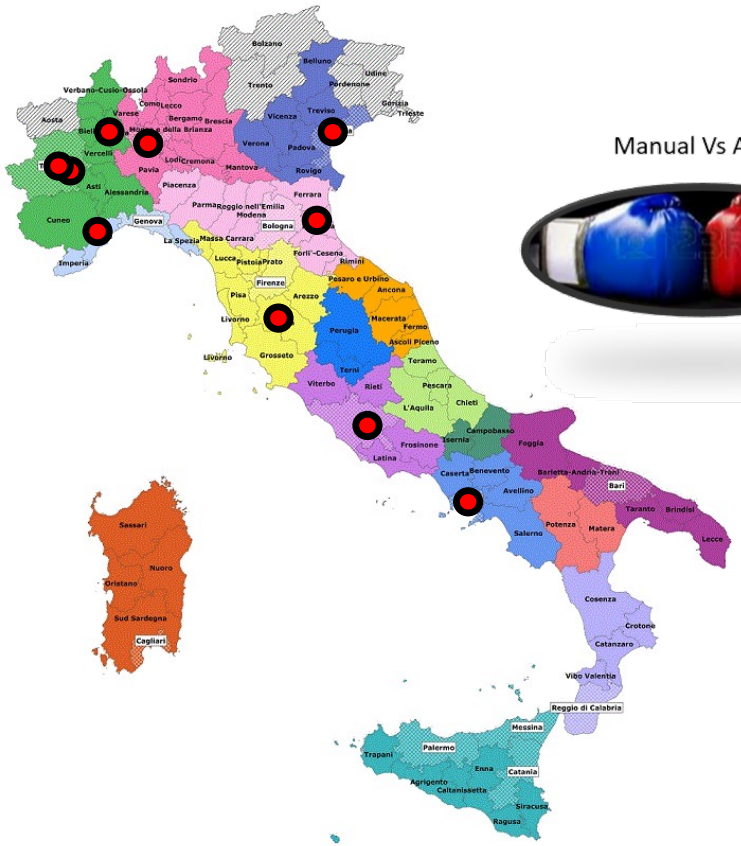


prostate



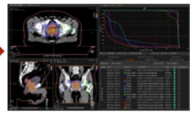
breast

Multi-centre prostate

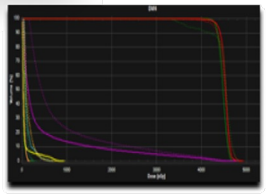


Manual Vs Auto

Clinical blind comparison (CBS)



DVH comparison



Radiotherapy and Oncology 148 (2020) 126–132

Contents lists available at ScienceDirect

Radiotherapy and Oncology

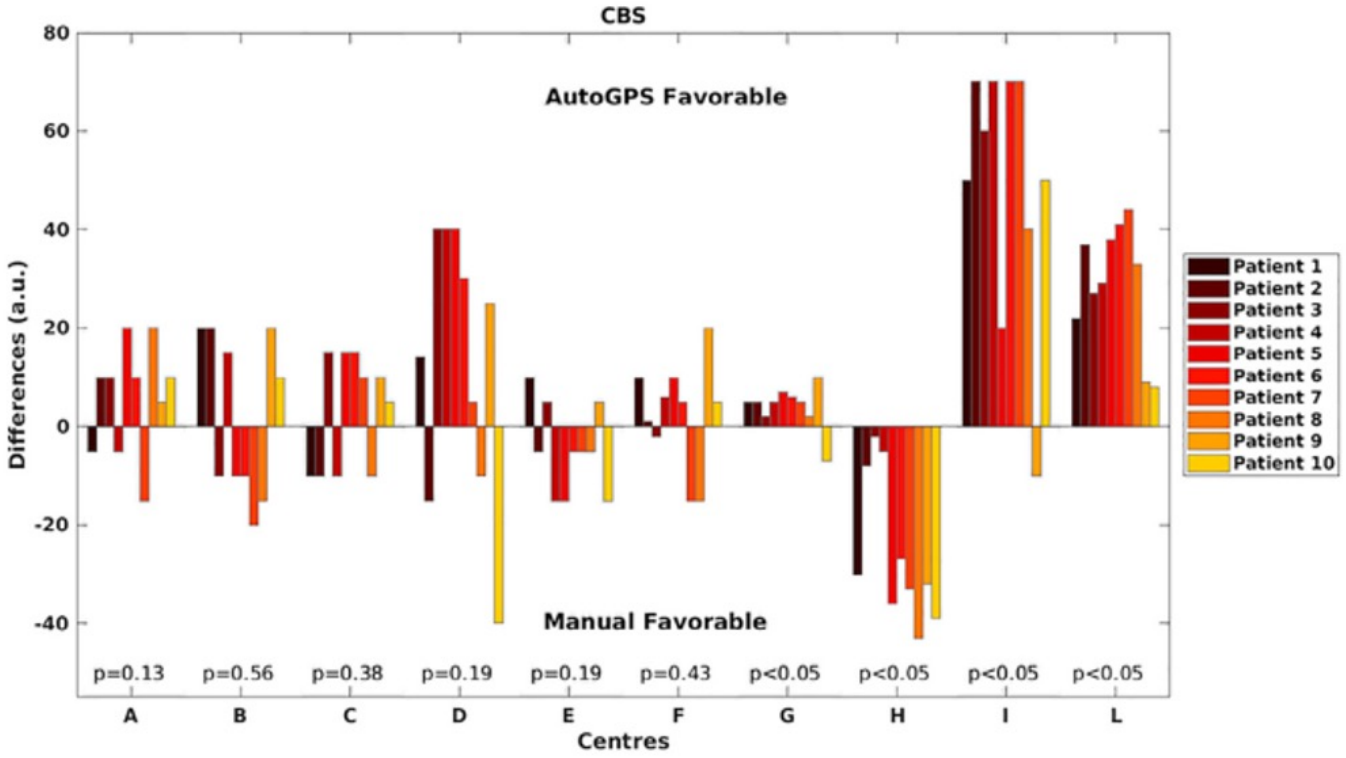
journal homepage: www.thegreenjournal.com

Original Article

Automatic genetic planning for volumetric modulated arc therapy: A large multi-centre validation for prostate cancer

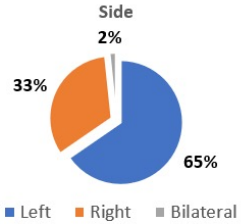
Christian Fiandra [a,b,*], Linda Rossi [c], Alessandro Alparone [d], Stefania Zara [d], Claudio Vecchi [d], Anna Sardo [e], Sara Bartoncini [f], Gianfranco Loi [g], Carla Pisani [h], Eva Gino [i], Maria Grazia Ruo Redda [j], Gian Marco Deotto [k], Paolo Tini [l], Stefania Comi [m], Dario Zerini [n], Gianluca Ametrano [o], Valentina Borzillo [o], Lidia Strigari [p,1], Silvia Strolin [p,1], Alessandro Savini [q], Antonino Romeo [r], Sonia Reccanello [s], Imad Abu Rumeileh [t], Nunzia Ciscognetti [u], Flavia Guerrisi [v], Gabriella Balestra [w], Umberto Ricardi [x], Ben Heijmen [c]

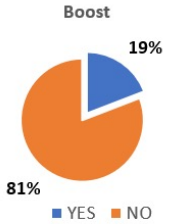
Multi-centre prostate

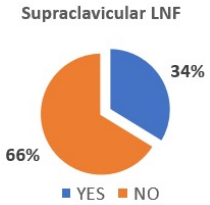


Multi-centre breast

- 24 centres
- 10 patients / centre
- 240 patients





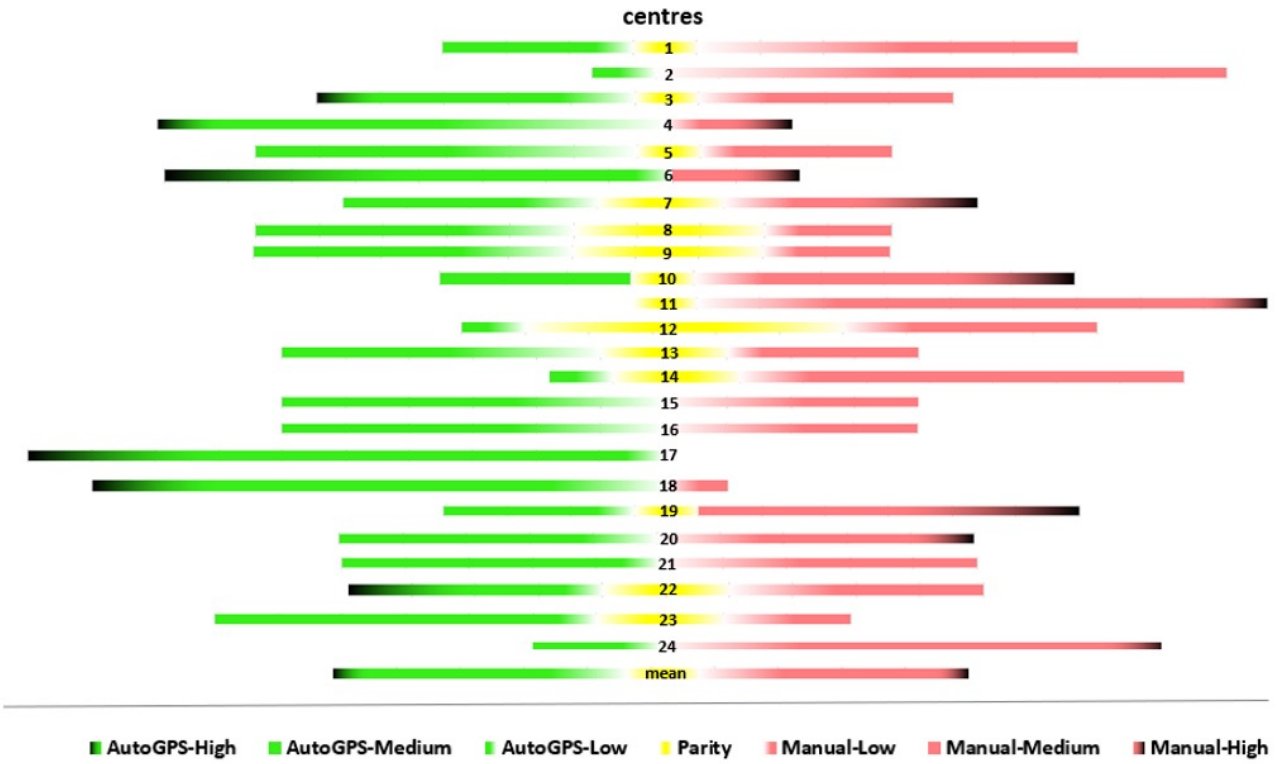


Real-world inverse planning for breast cancer: automatic versus manual plan in a large multi-centre Italian study

Christian Fiandra, Stefania Zara, Linda Rossi, Luca Reversi, Elena Pierpaoli, Paolo Ferrar, Lorenzo Placidi, Stefania Comi, Erminia Infusino, Manuela Coeli, Eva Gino, Tiziana Licciardello, Gianfranco Loi, Antonella Roggio, Alberto Ciarmatori, Ilaria Benevento, Angela Poggiu, Nunzia Ciscognetti, Anna Di Dio, Gianmarco De Otto, Nando Romeo, Elisabetta Verdolino, Federica Rosica, Stefano Ren Kaiser, Stefania Cora, Lidia Strigari, Maristella Marrocco, Umberto Ricardi and Ben Heijman.

OC – 0128 @ESTRO 2022

Multi-centre breast



- clinicians' sentences towards a substantial equivalence between manual and autoplans

GOAL ACHIEVED

Contents lists available at ScienceDirect

Physica Medica

journal homepage: www.elsevier.com/locate/ejmp

Implementation of automatic plan optimization in Italy: Status and perspectives

Stefania Pallotta [a,b,*], Livia Marrazzo [b], Silvia Calusi [a], Roberta Castriconi [c], Claudio Fiorino [c], Gianfranco Loi [d], Christian Fiandra [e]

[a] University of Florence, Department of Biomedical, Experimental and Clinical Sciences "Mario Serio", Florence, Italy
[b] Medical Physics Unit, AOU Careggi, Florence, Italy
[c] Medical Physics, San Raffaele Scientific Institute, Milano, Italy
[d] Medical Physics, AOU Maggiore della Carità, Novara, Italy
[e] University of Turin, Department of Oncology, Turin, Italy

125 medical physicists of the 175 contacted completed the survey.

Our survey shows that 49% of the responding centres have an automatic planning solution although clinically used in only 33% of the cases. A generally positive attitude toward automatic planning was reported, with a prevalence of expected benefit and enrichment for the medical physics profession.

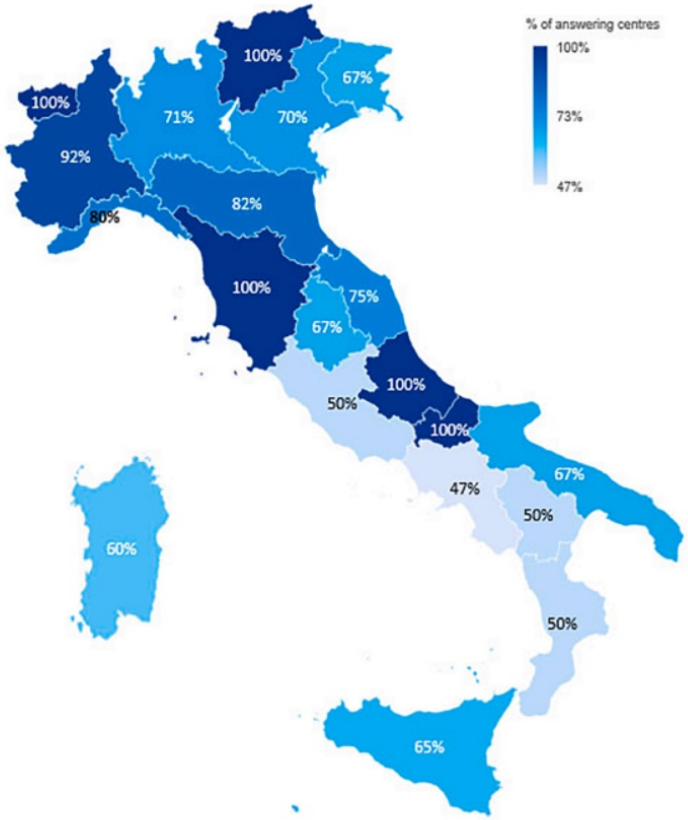


Fig. 1. Percentage of responding centres per region.

Thank you for your attention!!