

Experience with automated planning in busy international clinic setting



Clínica Iram – Santiago - Chile

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Standard Disclaimers

- **Speaker Disclosures.**
 - Reflects my own opinion and not necessarily represent to IRAM.
- **Conflicts of interest.**
 - None.



Alejandro Cuadra, MSc.



- **Physicist.**
 - Tarapaca’s University.
 - Pre grade
 - University of Chile.
 - Post grade in Physics.
 - Universitat Valencia, Spain.
 - Msc.Medical Physics.
- “Clínica IRAM” since 2002.
 - Quality Assurance in Radiotherapy.
 - Clinical Dosimetry Department.

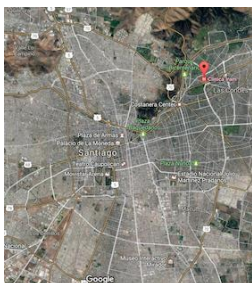


Clínica IRAM.

- Since 1978.
- > 3000 treatments per years.
- 15 Radiation Oncologists.
- 3 Physicists.
- 17 Dosimetrists.
 - 5 in inverse planning.
 - 12 in Linacs.
- 12 Technicians for supporting in Linacs.
- 1 engineer for service support.



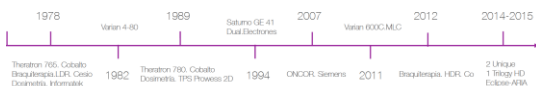
Clínica IRAM.





Clínica IRAM.

Technological development Iram Clinic



Dr. C.V. Sola, "Evaluación Tecnológica Iram, Desarrollo Organizacional y Planificación Basada en Conocimiento", SOCHRA, 2018.

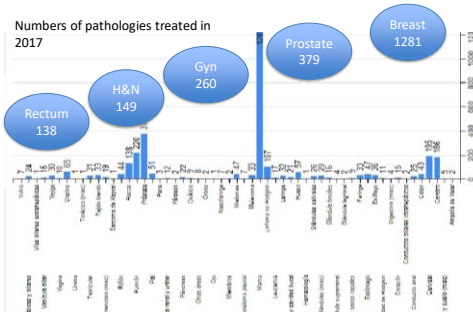


Clínica IRAM.

- SRS. (1996 – 2016 change system).
 - Cone system.
 - GE Saturne 41.
 - Siemens Oncor.
 - Brain metastasis and arteriovenous malformation (AVM).
- SBRT (2016).
 - Liver.
 - Lung.
 - Oligo metastasis.
- RPM (2016 - Breath hold modality).
 - Left breast.



Clínica IRAM.





Clínica IRAM.

- Iram's Workflow.
 - High workload by dosimetrist.
 - 7 to 10 planning per day.
 - Different level of training and knowledge.
 - Dependence of some professionals to develop more complex treatment plans.
 - Initially.
 - ID's Contour of Structures.
 - Configuration treatment fields and optimizations process.
 - DVH evaluation.

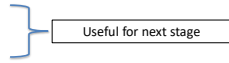


Workflow is time consuming



Clínica IRAM.

- First stage improvement.
 - Structures templates.
 - Color's code.
 - Structure's code.
- Optimization goals for different kind of treatments.
- Reduction of planning times.
 - Structures and optimization objectives connecting by code.
 - Reduce planning time compare with manual process.





Clínica IRAM.

- Second stage improvement.
 - Inclusion of clinical protocol.
 - A series of clinical protocols were created according to the treatment site
 - Define PTV and OAR dose limits parameters .
 - Faster plan evaluation.
- Significant decrease in planning times.
- Clinical protocol OAR evaluation in prostate fossa.

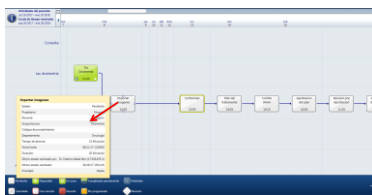
| Principal | Prescripción | | | | Precisión Dosis (GyE) | Dosis Total (GyE) | Dosis Total Real (GyE) |
|------------|---------------------|------|-----------------|-------|--------------------------|----------------------|---------------------------|
| PTV-T-2000 | Como mucho | 0.0 | % recibe más de | 220.0 | 7790.0 | 7790.1 | |
| PTV-T-2000 | Al menos | 95.0 | % recibe más de | 180.0 | 6650.0 | 6648.3 | |
| PTV-T-2000 | Al menos | 90.0 | % recibe más de | 180.0 | 6360.0 | 6358.3 | |
| PTV-T-2000 | Rango de referencia | | recibe | 200.0 | 7000.0 | 7000.0 | |
| CTV-T-2000 | Al menos | 90.0 | % recibe más de | 200.0 | 7000.0 | 6988.3 | |
| CTV-T-2000 | Al menos | 90.0 | % recibe más de | 180.0 | 6650.0 | 6648.3 | |
| PTV-T-2000 | Como mucho | 1.0 | % recibe más de | 214.0 | 7490.0 | 7488.3 | |

Varian Medical System, Inc., Eclipse v13.6 protocolo clinica



Clínica IRAM.

- Third stage improvement.
 - Workflow implementation.
 - Define responsibilities for each activity.
 - Assigned task execution times.
 - Automation of workflow tasks.



Varian Medical System, Inc., Eclipse v13.6 workflow



Clínica IRAM.

- Standardized workflows by type of treatments.
 - Different amount of steps according to Treatment.
 - Between 3 and 7 days.



Varian Medical System, Inc., Eclipse v13.6 workflow



Clínica IRAM.

- In summary.
 - Decrease in planning times.
 - Standardization of treatment plans.
 - Increase in the number of schedules.
 - Maintain the quality standard by evaluating clinical protocols.
- But these improvements do not replace the dependence of the experience of the Dosimetrist or Physicist in charge of the planning.....
- **Complex inverse planning in the hands of few physicists or Dosimetrist.**



Knowledge Based planning Implementation.

- Currently there are 2 dosimetrist in training in SW and RapidArc techniques.
- Aim: achieve transversality in the management of highly complex techniques among the dosimetrist staff.
- ¿How to achieve a fast and secure ability to develop high complexity treatment plans?

Knowledge Based planning Implementation.



- Chronology
 - Early January 2016 we had the help to develop and implement rapid plan by creating our own models.
 - Hypofractionated prostate.
 - 33 patients.
 - In the middle of October 2016 an on-site training was carried out to show us in a practical way.
 - Deborah Nelson.
 - In March 2017, Kevin Moore help us to validate our new models and try UCSD models with our patients.

Knowledge Based planning Implementation.



| RapidPlan model | Number of re-plan validations | Notes |
|------------------------------|-------------------------------|---|
| IRAM prostate | 7 | Used existing IRAM model, one round of filtering, new optimization objectives |
| IRAM APBI Left Breast | 7 | 5-field static field sliding window |
| IRAM Lung (Stage III) | 5 | |
| UCSD Prostate Bed | 7 | |
| UCSD Head-and-Neck | 6 | Added POST NECK as avoidance to model, per IRAM institutional practices |
| UCSD Prostate + Pelvic Nodes | 5 | Unpublished UCSD model |
| UCSD Liver SBRT | 3 | Unpublished UCSD model |
| UCSD Lung SBRT | 3 | Both UCSD Right and Left Lung SBRT models loaded onto IRAM database |
| Total: 48 | | |

Validation IRAM models and UCSD models with IRAM's patients, Dr. Kevin Moore

Knowledge Based planning Implementation.

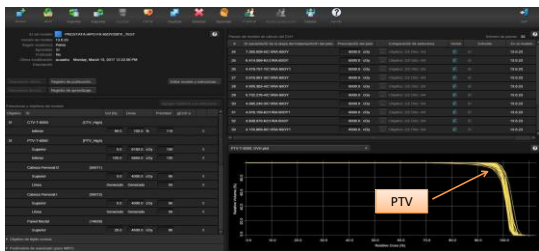


- Consideration of hypofractionated prostate model:
 - Specific model, requires few patients for optimal performance.
 - There is little variability between the structures.
 - Comparison of commonly made manual plans versus RapidPlan plans.
 - Plans calculated with the RapidPlan model were all clinically accepted.

Knowledge Based planning Implementation.



Model configuration

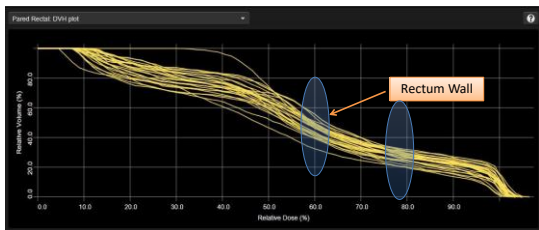


Varian Medical System, Inc., Eclipse v13.6, Model configuration

Knowledge Based planning Implementation.



Model configuration

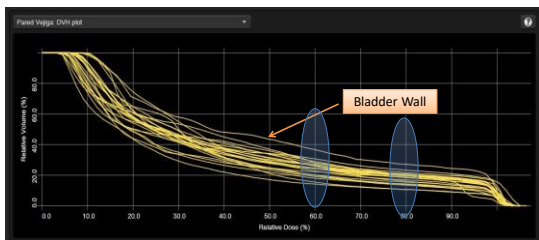


Varian Medical System, Inc., Eclipse v13.6, Model configuration

Knowledge Based planning Implementation.



Model configuration

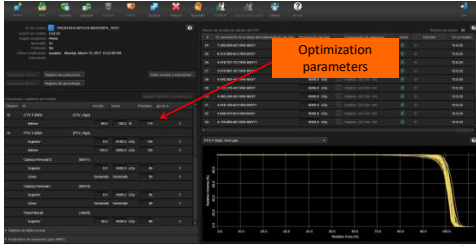


Varian Medical System, Inc., Eclipse v13.6, Model configuration

Knowledge Based planning Implementation.



Model configuration

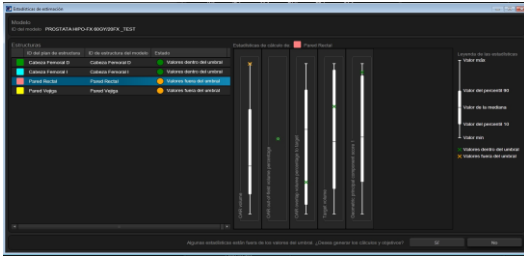


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Knowledge Based planning Implementation.



Estimation statistics

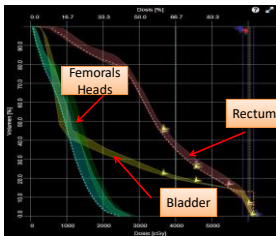


Varian Medical System, Inc., Eclipse v13.6, Model estimation

Knowledge Based planning Implementation.



DVH estimation



Varian Medical System, Inc., Eclipse v13.6, Model estimation

Knowledge Based planning Implementation.



- Other models implementation in Clinica IRAM (since January 2017).
 - Prostate model 76Gy.
 - Prostate fossa70Gy.
 - Pelvis + lymph nodes.
 - Acelerated Partial breast irradiation.
 - Head and neck (data base).
 - GBM (data base).
 - Lung (validation process).
 - Rectum.

Knowledge Based planning Implementation.

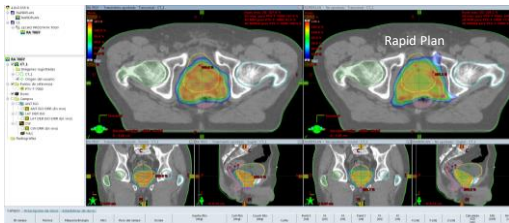


- UCSD Models used in Clinica IRAM.
 - Prostate and prostate fossa.
 - Pelvis + lymph nodes.
 - Head and neck.
 - Gynecological.
 - SRS.
 - SBRT lung.
 - SBRT Liver.
- Test and compare UCSD models with local data.

Knowledge Based planning Implementation.

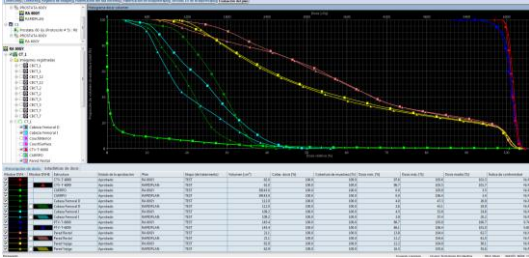


IRAM Prostate model Hypofractionated



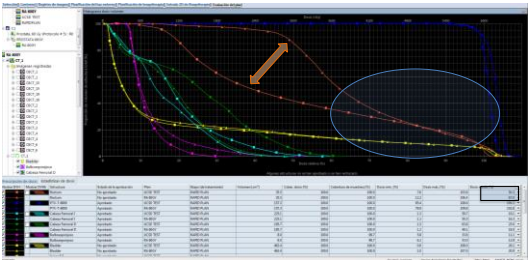
Varian Medical System, Inc., Eclipse v13.6 external plan beam

Knowledge Based planning Implementation.



Varian Medical System, Inc., Eclipse v13.6 external plan beam

Knowledge Based planning Implementation.

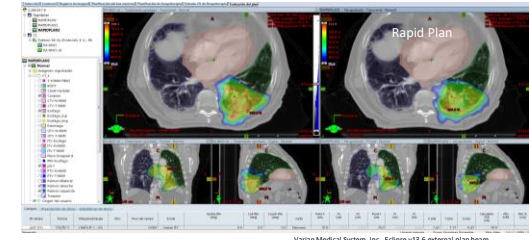


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Knowledge Based planning Implementation.

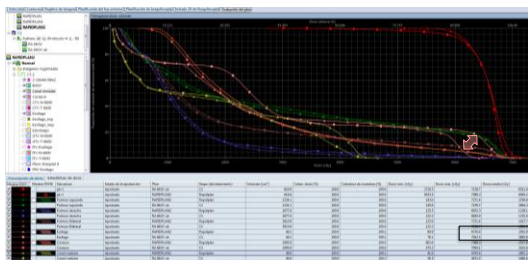


IRAM Lung model Stage III



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Knowledge Based planning Implementation.

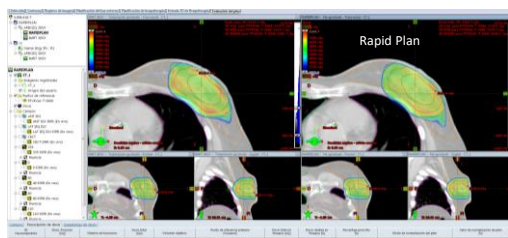


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Knowledge Based planning Implementation.

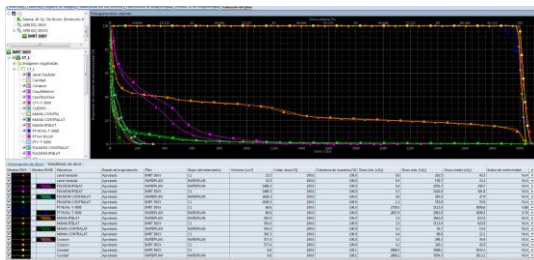


Accelerated Partial Breast Irradiation model



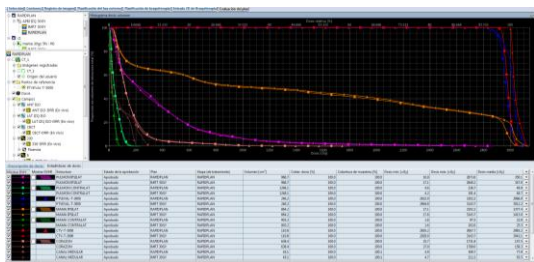
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Knowledge Based planning Implementation.



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Knowledge Based planning Implementation.

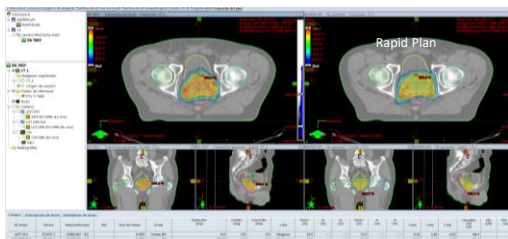


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Knowledge Based planning Implementation.

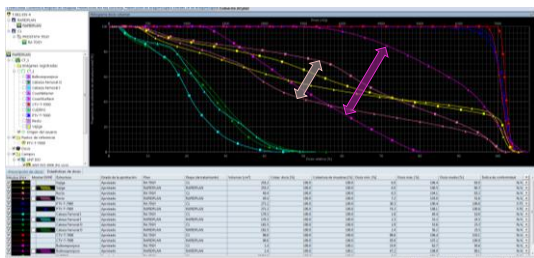


UCSD Prostate model, modified optimization parameters



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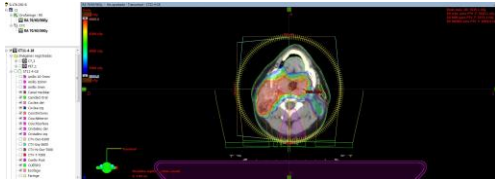
Knowledge Based planning Implementation.



Knowledge Based planning Implementation.

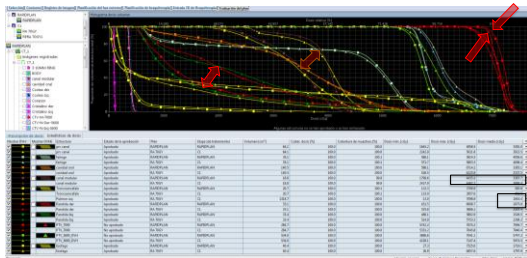


USSD Head and Neck model.



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Knowledge Based planning Implementation.

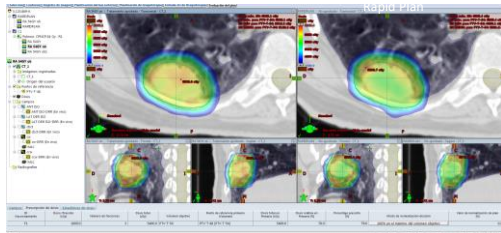


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Knowledge Based planning Implementation.



UCSD SBRT Lung model.



Varian Medical System, Inc., Eclipse v13.6 external plan beam

Knowledge Based planning Implementation.



Knowledge Based planning Implementation.



- Creating a model.
 - At least 20 patients to create a model's knowledge-based planning.
 - More complex models require more patients.
 - Validate the model with plans already calculated.
 - Decrease planning time.
 - Improve consistency.
 - Expand current IMRT and VMAT opportunities with minimal impact on current staffing levels.
- Preliminary results.
 - Minimize training time of new staff.

Preliminary results



| Prostate Hypo | Manual plan | RapidPlan™ |
|---------------------|----------------------------------|----------------------------------|
| Clinical evaluation | Optimal | Optimal |
| User | Advance | Minimal training |
| Time planning | 60 min. | 30 min. |
| Key features | Variability in dose distribution | Consistency in dose distribution |

| 2018 | Hypo | Prostate and Prostate Fossa. | Prostate + Limph |
|-----------------|------|------------------------------|------------------|
| Nº planning | 41 | 37 | 119 (15) |
| Nº optimization | 1 | 1 | 1 or (2) |
| Time (min)± | 30 | 30 | 45 |



Preliminary results

| Head and Neck | Manual plan | RapidPlan™. |
|---------------------|--|----------------------------------|
| Clinical evaluation | acceptable | Optimal |
| User | Advance | Minimal training |
| Time planning | 4 hrs. | 30 - 45 min. |
| Key features | High heterogeneity in different dose levels. | Consistency in dose distribution |

| 2018 | Head and Neck |
|-----------------|---------------|
| Nº planning | 55 |
| Nº optimization | 1 (2) |
| Time (min)± | 45 (70) |



Preliminary results

| APBI | Método Manual | RapidPlan™. |
|---------------------|-----------------------------|---------------------|
| Clinical evaluation | Optimal | Optimal |
| User | Advance | Minimal training |
| Time planning | 60 min. | 25 min. |
| Key features | dependence on beam geometry | fewer optimizations |

| 2018 | APBI |
|-----------------|------|
| Nº planning | 86 |
| Nº optimization | 1 |
| Time (min)± | 25 |



Preliminary results

| 2018 | Rectum | Gyn |
|-----------------|----------|----------|
| Nº planning | 108 (15) | 123 (10) |
| Nº optimization | 1 (2) | 1 (2) |
| Time (min)± | 35 | 40 |



Conclusions.

- General considerations
 - Change in the technological platform at Clínica IRAM allowed the development of high precision radiotherapy.
 - Automated Clinical Protocols -RapidPlan- improve security and decrease planning time.
 - Accelerate the learning curve of dosimetrist.
 - RapidPlan can allow clinics to reduce variability in treatment planning to achieve greater consistency, efficiency and quality in patient care.



Thanks for your attention

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