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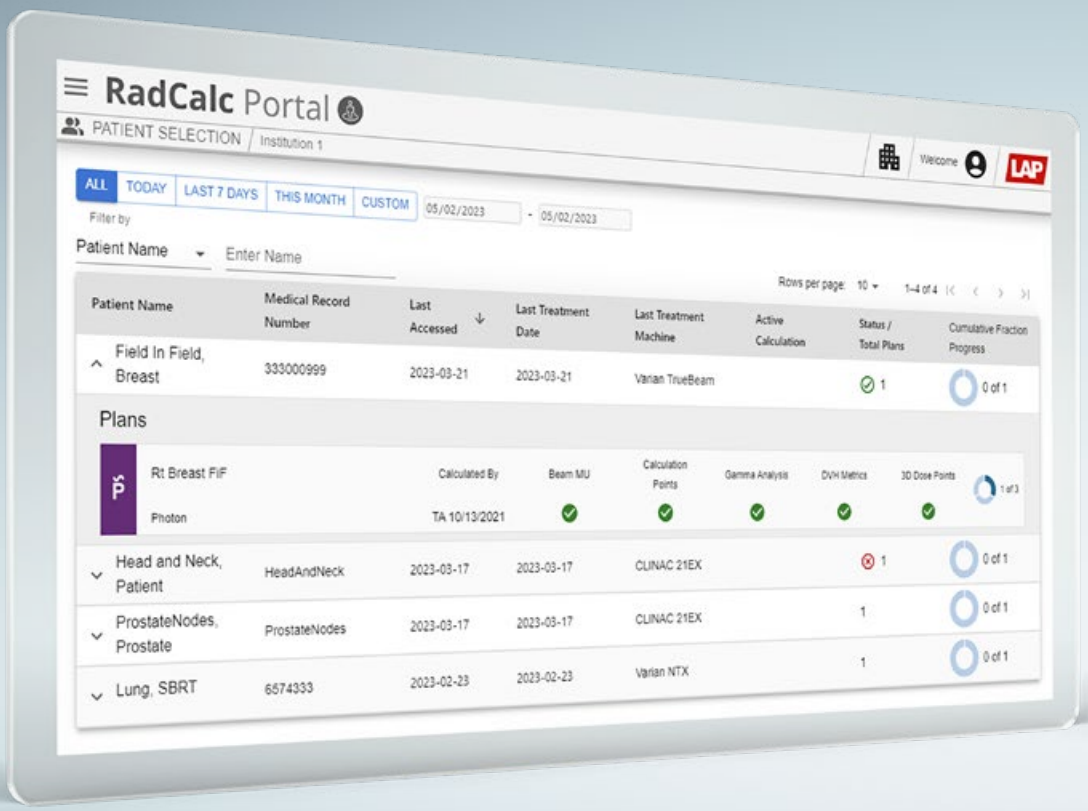


RadCalc QA Software

Advanced platform for independent and unbiased patient quality assurance

RADCALC

Simply Precise


St. George Hospital

Why patient QA?

Safety is a priority in radiation therapy. Protecting patients against ionizing radiation to healthy tissue is essential therefore every measurement must be as accurate as possible. Various QA processes can produce different results; therefore, it is imperative to independently verify calculations a second time.

→ *This is exactly what RadCalc does: independently verify dosimetric calculations in an easy-to-use software platform.*

How do you check calculations of the treatment planning system?

Fast and fully automated patient-specific RT plan QA is a big step towards a QA process conforming to global standards. RadCalc QA software checks RT plans fast and easy, which allows for more time for your patients. Simply import the RT plan from your planning system. RadCalc automatically calculates in the background with independent algorithms whether irregularities or deviations are present. As a result, you receive an analysis report. This saves you valuable time and provides you a second check on the calculation of the therapy planning system – fully automated. Enhance safety with an independent secondary check, which perfectly suits your existing QA process.

"Nearly 60 % of the reported errors involved a lack of an appropriate independent secondary check of the treatment plan or dose calculation."

According to IAEA Technical Report 430

Seamless and easy

Patient-centric workflow

Included with every install, RadCalcAIR (Automated Import & Reporting) provides an automated process with tools for percent difference, DVH, Gamma and Distance to Agreement analysis and more.

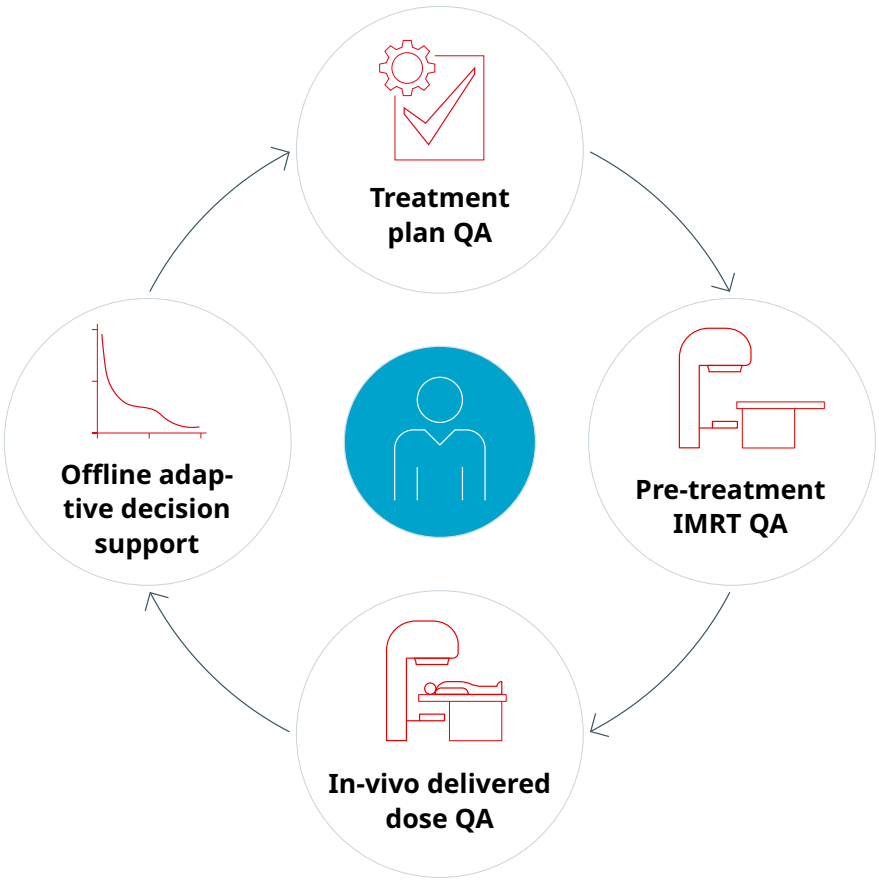
RadCalcAIR imports the treatment plans and performs the calculations and evaluations, based on the defined settings. The results can be exported, without user interaction, alerts are sent if parameters exceed set values.

RadCalcAIR also automates the EPID dosimetry module, providing true composite 3D pre-treatment QA and in-vivo dosimetry phantom-less workflows. Working with RadCalc can eliminate phantom-based plan verifications.

"This work is the result of over 20 years of expertise in application of MC simulations in radiotherapy.
With the RadCalc MC module we had the goal to bring fast MC calculations to the clinic in a user-friendly way."

Marc-André Renaud

Medical Physicist
McGill University, Montreal



Treatment plan QA

- Increasing complexity of radiotherapy plans requires critical accuracy for safe deliveries
- RadCalc's globally utilized 3D Monte Carlo, incorporating BEAMnrc and Collapsed Cone algorithms, instills confidence and sanity among clinicians

Pre-treatment IMRT QA

- RadCalc offers 3D true composite EPID absolute dosimetry and treatment log file 3D dose volume reconstruction
- Truly independent solution for direct comparison to the intended plan
- Designed for an automated and seamless workflow

In-vivo delivered dose QA

- RadCalc's absolute dosimetry and unique true 3D composite nature eliminate baseline collection and second calculations
- Continuous monitoring of treatment delivery data allows for fractional machine QA
- Enables comparison with pre-treatment QA and integration into in-vivo EPID dosimetry workflow

Offline adaptive decision support

- Enhances independent dosimetric validation calculations for speed, ease, and accuracy
- Dosimetric calculations provide a truly patient-focused QA routine that is seamlessly integrated into adaptive radiation therapy workflows

Precision meets simplicity

RadCalc is the advanced platform for independent and unbiased patient QA. The seamless integration into existing workflows increases efficiency and safety. Comprehensive documentation and plan analysis tools offer the features medical physicists need.

- → *Identify clinically relevant deviations within the entire patient volume using the 3D Monte Carlo or 3D Collapsed Cone algorithms.*
- → *Increased accuracy for point dose with ray tracing of the densities found in the CT dataset.*
- → *Automate your calculations and evaluations while also having additional tools available to identify where deviations occur.*
- → *Save time while also having the opportunity to work remotely.*

Fast

A fully automated import and export is much faster when compared to manual data entry and eliminates transcription errors.

Accurate

Studies have shown the verification dose to be within ±3 % of the treatment plan dose providing excellent accuracy.

Powerful

Most common treatment plans can be verified with RadCalc QA software. Comprehensive analytical features provide powerful tools for physicists for plan analysis.

Independent

RadCalc provides the opportunity to check all results independently from the manufacturer's TPS. This ensures unbiased third-party validation.

Easy

Due to its user-friendly interface, the software is easy to use. Clear structure, guided menus and a sophisticated layout make the recurring tasks simple and time-saving.

Automated

RadCalc can seamlessly be integrated into the clinical workflow. Automate our QA workflow for all calculation types using RadCalcAIR.

Accuracy is key

Secondary check of treatment planning

Electron & photon calculations

Fast calculations can be performed by using the EZ photon and electron tools. For electron calculations, a library of custom cutouts can be maintained. Cutout factors can be computed using a sector integration or square root method.

3D off-axis assistance

RadCalc's use of 3D coordinates simplifies the process of off-axis calculations by automatically computing the off-axis distances in the Beams Eye View (BEV). The tool can also be used to manually position additional off-axis point, without needing to go back into the TPS.

Refined Clarckson implantation for modulated treatment plans

RadCalc utilizes a Modified Clarkson Integration (MCI) and when including the planning CT, RadCalc's ray tracing capabilities provide improved accuracy of point dose calculations. Additionally, view MLC and calculate fluence and dose map patterns.

Plan comparison

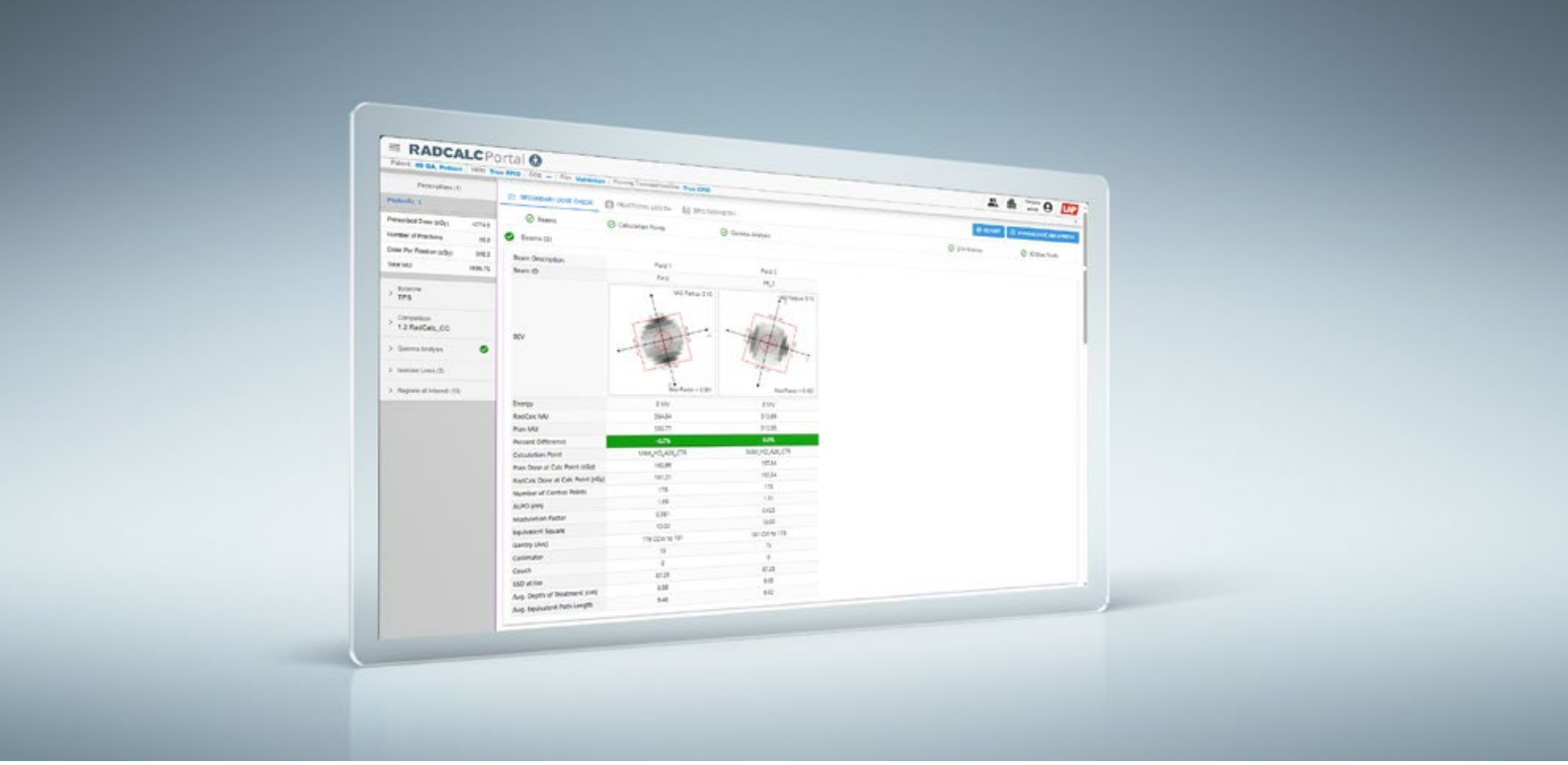
This unique RadCalc feature allows users to compare the plan from the R&V system with the plan data directly exported from the TPS, thus discovering errors during the plan export process. They can also easily analyze two arbitrary plans and quickly highlight the difference in plan parameters side by side.

Fluence and dose map

Users can extend the pre-treatment MU verification with comparing RadCalc calculated dose map with a measured, or TPS calculated dose map and with comparing the RadCalc calculated fluence with TPS fluence.

RadCalc LINAC Logger

The RadCalc LINAC Logger produces delivery log files through an external utility to allow users to gather machine operating information from all Elekta LINACs for use within the RadCalc software.



3D Functionalities

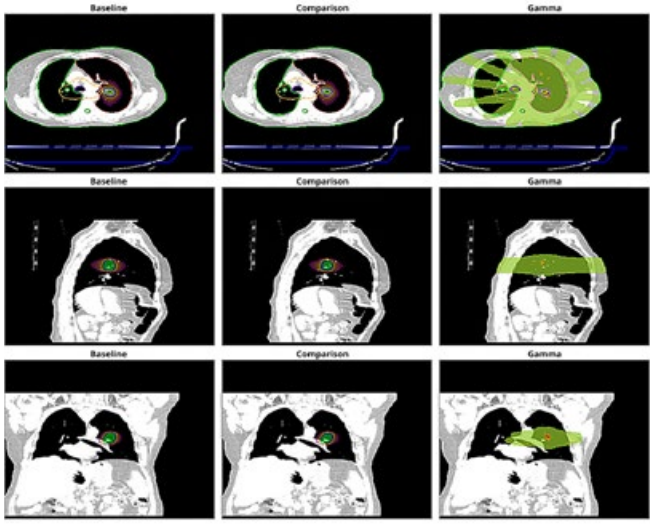
Smart QA instead of basic verification

Basic 2nd check procedures

- Verifies dose at single points
- Considers the patient as a box
- Relies on complex processes with manual work & corrections
- Uses general standards
- Time-consuming & costly with hardware phantom

Independent & patient-centric QA with RadCalc

- Conducts a volumetric measurement
- Considers patient as a whole
- Evaluating dose directly on planning CT
- Uses automated workflows
- Bases on the gold standard of algorithmic dose measurement
- Saves up to 30 % of QA time

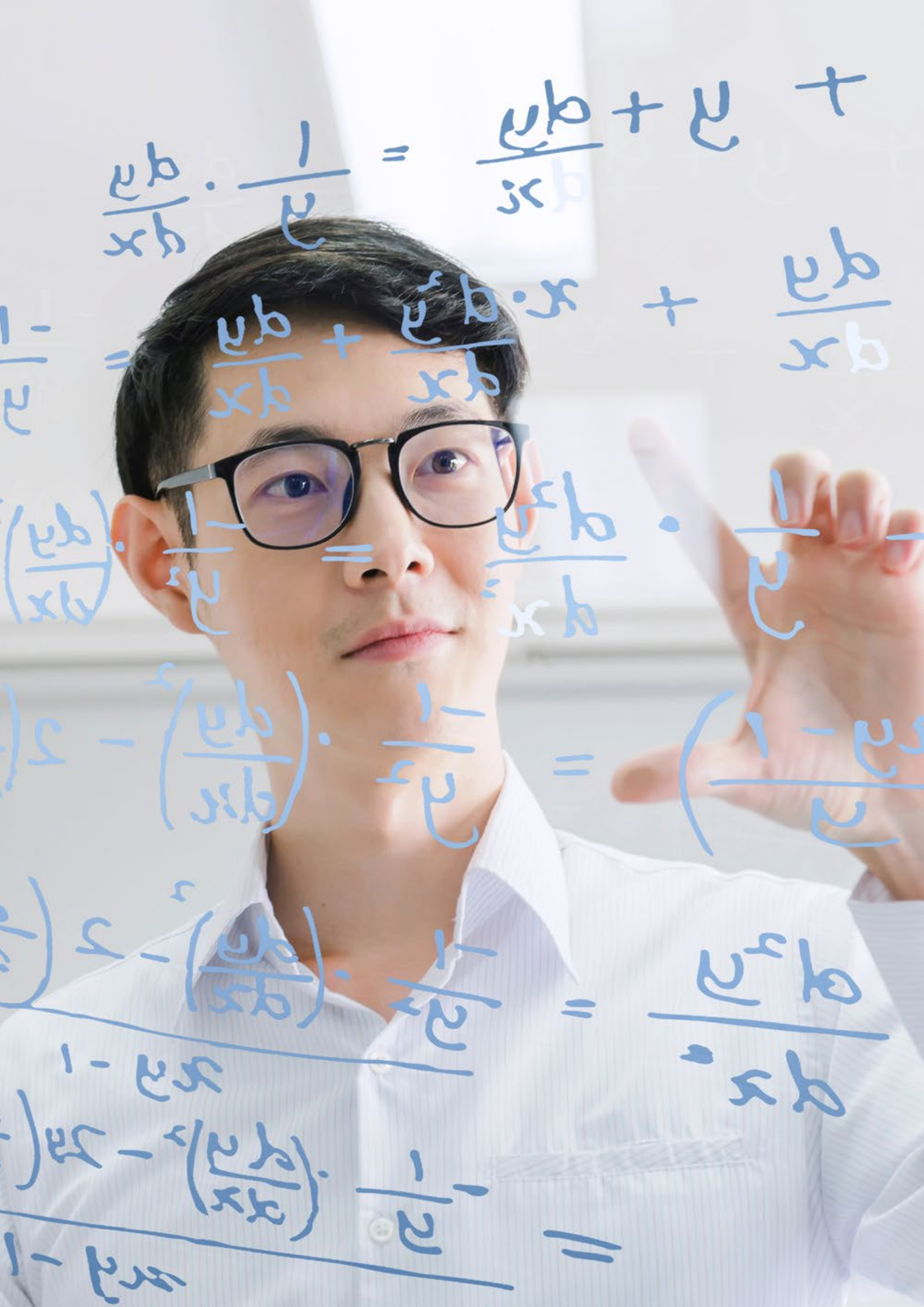


3D Dose analysis

RadCalc provides Percent difference, DVH, Distance to Agreement, Gamma analysis tools to evaluate 3D computations. The functionality includes RadCalcAIR (Automated Import & Report) providing a fully automated process for plan import, computation, 3D dose analysis and report generation. RadCalc's fully automated process immediately alerts you to plans that fail to pass your pre-set Gamma analysis acceptance criteria. RadCalc allows automatically applying different Gamma calculation defaults and acceptance criteria based on user-defined rules.

DVH Protocols

Any number of DVH protocols can be defined from the analysis screen within RadCalc. Using rules in RadCalc, different DVH protocols can be automatically selected and applied to the specific plan. RadCalc automatically checks whether the DVH objectives are met for critical structures using both the TPS and RadCalc's 3D dose. Analysis reports are automatically attached to your verified plan and sent to your workstation via email or to a directory of your choice on your server.



Calculation Algorithms

Besides the Clarkson algorithm for point dose calculations RadCalc provides Collapsed Cone Convolution Superposition and Monte Carlo-based algorithm modules that deliver fast, easy, and accurate 3D Dose Volume verification for the most commonly used treatment planning systems. Treatments have become more complex with higher dose per fraction. Monte Carlo is widely recognized as the gold standard dose calculation method. RadCalc's 3D Monte Carlo module employs the most established Monte Carlo dose engine available (BEAMnrc), and also utilizes proprietary machine modelling acquired from McGill University. Doses in inhomogeneous structures such as lung tissue are calculated with very high accuracy. Sparing healthy tissue is always a major goal in radiation therapy. Hence, dose calculation accuracy is imperative.

"Since the very beginning of the adoption of IMRT at our department (year 2001) I was convinced of the importance of a second check of the MU calculation. We're glad of being the first Italian site using RadCalc 3DMC."

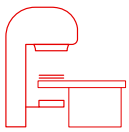
Mauro Iori

Medical Physicist PhD, Head of the Unit of Medical Physics
Azienda Unità Sanitaria Locale di Reggio Emilia – IRCCS

RadCalc EPID for pre-treatment dosimetry

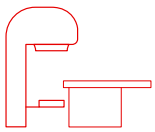
Tackling risks of high error sensitivity

RadCalc's EPID module delivers TG 307/218 compliant pre-treatment and in-vivo calculations. Acquired in-vivo images are transmitted back through the patient to determine the incident fluence, differentiating it from all other available solutions.



Potential error detection with phantom-based measurements

- Data transfer corruption
- Deliverability of dose
- Checks TPS dose on phantom
- Spends additional time on aligning and calibrating phantoms
- Uses 2D planar dose measurements
- Costly and time-consuming



Potential error detection with on-board imager and RadCalc software

- Data transfer corruption
- Deliverability of dose
- Checks TPS dose on volumetric patient image
- Saves up to 20 % of QA time
- Uses reconstructed 3D measurements

Simple to use

RadCalc's EPID module utilizes the collected integrated measurements for all static and dynamic beam segments to reconstruct 3D dose on the patient's real anatomy using RadCalc's Collapsed Cone algorithm.

Supported modalities

Supporting commercially available linear accelerators with integrated EPID panels for all treatment techniques.

True composite

Actual dose delivered is compared with both the intended dose from the TPS and RadCalc's 3D dose reconstruction for a thorough pre-treatment QA.

Inherent sensitivity

RadCalc's implementation exploits the inherent sensitivity of the EPID to changes in the patient making it a valuable tool for analyzing deviations from the intended dose.

Versatile

Which treatment techniques are supported?

Hypofractionation

During hypofractionation higher doses are delivered to the target within a treatment, than during normal radiation therapy. Accuracy of these treatments is therefore essential. RadCalc's 3D Monte Carlo module employs the most established EGS-system-based BEAMnrc Monte Carlo algorithm which utilizes proprietary machine modelling acquired from McGill University. Doses volumes verified with RadCalc thus increase patient safety and plan quality by enhancing your ability to more accurately verify complicated treatment plans. Studies have shown the verification dose to be within ±3 % of the treatment plan dose providing very high accuracy.

Adaptive radiation therapy

Radiation therapy continues to grow in complexity, consequently the task of quality assurance has become more time-consuming. RadCalc was developed by an ABR board-certified physicist to make the task of performing independent dosimetric validation calculations much faster, easier and more accurate.

RadCalc's dosimetric calculations provide a fully automated process for your QA routine, which can be seamlessly integrated into adaptive radiation therapy workflows.

SRS/SRBT

RadCalc provides Monte Carlo and Collapsed Cone Convolution Superposition algorithm modules that deliver fast, easy, and accurate 3D dose volume verification. Utilizing a patient's planning CT for calculations, RadCalc's 3D functionality offers verification for 3D, IMRT, VMAT, and SRS/SBRT plans.

Dose throughout the treatment volume is verified with RadCalc, thus increasing patient safety and plan quality by enhancing your ability to verify complicated SRT/SBRT treatment plans more accurately.

Intensity Modulated Radiation Therapy – IMRT

RadCalc's 3D Collapsed Cone, 3D Monte Carlo and point dose calculation algorithm support step-and-shoot, sliding window and compensator-based IMRT treatment plans. With regard to point dose-based second check for IMRT, the computation is performed utilizing a modified Clarkson scatter integration along with a head scatter algorithm to improve accuracy. The MLC leaf sequence patterns can be imported into RadCalc through various mechanisms. The MLC patterns can be changed and exported to a R&V system.

Volumetric Arc Therapy – VMAT

A regions of interest module is part of RadCalc's photon calculations for performing second check verifications for VMAT. ROI structures are exported with the plan file from the VMAT calculation to the RadCalc software. Average densities for the various structures can be either imported or manually entered. RadCalc computes an independent depth and effective depth value for each individual control point as well as the dose comparison for all imported calculation points. Additionally, an average depth and effective depth are determined. Users can also utilize the volume average dose tool to analyze the variation in dose (at a given distance) around the primary calculation point.

Brachytherapy techniques

RadCalc follows the TG-43 protocol to perform 3D dose volume and point dose verification for HDR (incl. Xoft), LDR and for Permanent Implant treatments. The TPS and RadCalc dose can be compared side by side in either 2D or 3D views. Isodose levels can be displayed, dose volume analysis can be performed using Percent Difference DTA or Gamma analysis and DVH protocols can be used.

RadCalc can compute the dose and DVH based on translated and/or rotated source for an individual treatment. Comparing the isodoses, DVH with the optimal source position the clinical impact of a source mislocation can be evaluated.

Modular and multitasking

Supported modalities

RadCalc includes comprehensive institution and physics data setup, import of radiation therapy plans, automated dosimetric calculations, and export to record and verify systems. RadCalc also provides powerful reporting tools and flexible site licensing.

→ *Calculations and evaluations can be done automatically in the background, without user interaction.*

MR-LINACs

RadCalc supports secondary point dose and MU verification for MR-LINACs. The calculations take the presence of the magnetic field into account, through the imported measurement profiles. All calculations can be automated together with RadCalc's import, export and reporting features.

TomoTherapy

RadCalc supports TomoHelical, TomoDirect and TomoEDGE and verifies the treatment time and dose to multiple calculation points. Each control point can be visualized together with the illustrated leaf open times. If more accuracy is required, perform full 3D volumetric Monte Carlo calculations. Additionally, the sinogram can be displayed.

Cobalt 60

The Co60 treatment plans can be imported from treatment planning system or from any supported record and verify system. They can contain wedges, blocks and cutouts which can be imported with the plan or defined manually in RadCalc.

LINACs

Besides the 3D Dose calculations with Collapsed Cone or Monte Carlo algorithms, RadCalc performs independent MU or point dose verification calculations for conventional 2D and 3D treatment plans, including electron, photon, MLC, 3D off-axis, diode and wedge support. Additional functionality is available with RTP import, R&V export and IMRT utilities.

CyberKnife

RadCalc supports CyberKnife machines equipped with fixed Cone, Iris or MLC. The treatment plan can be imported from MultiPlan or from Precision TPS. RadCalc provides point dose calculation options and other features for CyberKnife machines, such as fully automated calculation and reporting.

Superficial

RadCalc superficial calculations are based on real measured values. The software allows the definition of multiple energies with individual HVL values and energy-specific parameters. Every energy can have a list of allowed SSDs, cones and measured backscatter factors.

Halcyon/Ethos

RadCalc provides 3D Collapsed Cone, 3D Monte Carlo and point dose verification for Halcyon and Ethos machines, supporting Varian's dual-layer MLC. For 3D calculations features such as dose volume analysis and Gamma calculation, DVH protocols and analysis lines can be utilized.

Gamma Knife

RadCalc performs point dose verification calculations for various Gamma Knife versions and the Leksell GammaPlan (LGP) planning system. It stores and maintains a copy of the Elekta proprietary data providing independent table lookup and interpolation processes.

Brachytherapy

RadCalc supports intracavitary radiotherapy calculations for permanent seed implant, LDR, HDR and Xoft Brachytherapy machines. The calculations are 3D calculations based on the TG-43 protocol. DVH can be calculated with original or translated/rotated source positions and can be compared to imported DVH, and against DVH protocols.

Modality overview and corresponding features

Features of RadCalc modules

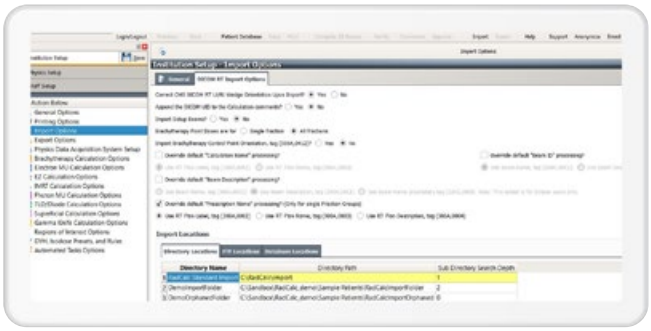
	MR-LINAC	LINAC (Photon)	LINAC (Electron)	Halcyon	Tomo-Therapy	Cyber-Knife	Gamma-Knife	Cobalt 60	Super-ficial	Brachy-therapy
Point dose verification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MU or treatment time verification	✓	✓	✓	✓	✓	✓		✓	✓	
3D ROI visualization	✓	✓		✓	✓	✓	✓	✓		✓
3D dose calculation and analysis		✓ MC/CC		✓ MC/CC	✓ MC					✓ TG-43
DICOM RT or other proprietary import	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R and V import/export	✓	✓	✓	✓		✓		✓	✓	✓ (Import)

Advanced features

	MR-LINAC	LINAC (Photon)	LINAC (Electron)	Halcyon/ Ethos	Tomo-Therapy	Cyber-Knife	Gamma-Knife	Cobalt 60	Super-ficial	Brachy-therapy
Support of wedge, attenuator, block/cutout, bolus, compensator	✓	✓	✓ (Bolus and cutout)	✓				✓	✓ (Cutout)	
In-vivo diode calculations supported	✓	✓	✓	✓	✓	✓		✓		
DVH calculation and analysis, isodose levels supported		✓		✓	✓					✓
Plan data comparison supported	✓	✓	✓	✓		✓	✓	✓	✓	
Automated import, calculation and reporting	✓	✓	✓	✓	✓	✓		✓	✓	✓
Ray tracing with CT densities for point dose		✓		✓	✓	✓				


St. George Hospital

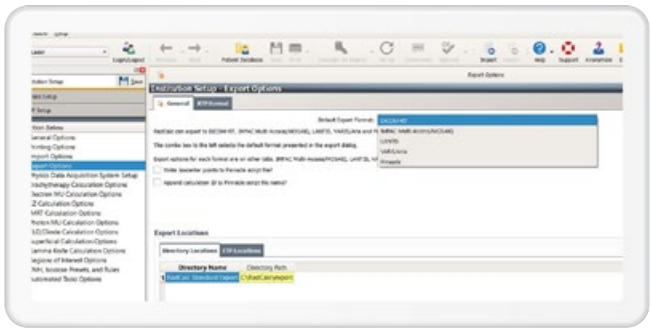
RadCalc's import utilities



RadCalc allows you to import from radiation therapy planning systems, verify and record systems, and/or virtual simulation software through DICOM RT or other proprietary formats. Third-party products supported by RadCalc:

- DICOM RT
- RTP Format: IMPAC/MOSAIC, LANTIS, Varis
- Pinnacle: DICOM RT, Hotscript, Direct FTP connection (Prior to Pinnacle version 9.0)
- Eclipse: DICOM RT, print template in Eclipse to provide missing effective depth information
- MIMiC Plan: hybrid plan import
- CyberKnife: from MultiPlan and Precision TPS
- Nucletron Plato Brachytherapy: direct FTP connection
- GammaKnife: direct import from the GammaPlan ODBC database
- Zap-X plan: import from the Zap-X treatment planning system

RadCalc's export utilities



RadCalc provides an export utility that allows users to export treatment plans to a format readable by a record and verify system. Exporting to record and verify systems saves re-entry of data, ensures that patient's medical records contain the verification results and allows users to export customized plans for special QA processes. Transferred data includes:

- Treatment field parameters and MU
- Beam name
- Gantry angle
- Collimator angle
- Couch angle
- Field size
- Treatment depth
- SSD
- Treatment dose
- Wedge information
- Either static or dynamic MLC leaf sequences
- Prescription information

Users may export plans and calculations to any record and verify system that accepts DICOM RT or RTP Connect format files.

RadExporter

- Simplified DICOM export from Eclipse using scripting API
- Generate calculation points automatically, eliminating the need for manual creation in the plan before export
- Export multiple plans for a treatment course simultaneously
- Preview second check results and export report to ARIA without leaving Eclipse External Beam workspace

Which hardware is required?

General requirements

Operating System	Microsoft® Windows® 7, 8, 8.1, 10, 11, 32-bit and 64-bit operating systems
Processor	Intel i5 or equivalent
Memory	8 GB (RAM)
Video	Minimum resolution 1024 × 768 and minimum 1 GB video memory (RAM)
Graphics	OpenGL 1.1 support required
Hard drive space	512 GB available. Varies with quantity and type of patient data

Recommended dose engine hardware specifications Collapsed Cone Module

Operating System	Windows 64-Bit OS (8, 10, Server 2012, 2016, 2019, or 2022)
GPU	NVIDIA GeForce RTX 2080 Ti, or better (must be NVIDIA)
CPU	Intel Core i7-9700, 8 Core, 12 MB cache, or better
RAM	16 GB or more
Disk	512 GB SSD or more

Recommended dose engine hardware specifications Monte Carlo Module

Operating System	Windows 64-Bit OS (8, 10, Server 2012, 2016, 2019, or 2022)
CPU	Dual Intel Xeon Gold 5220, 2.2 GHz, 3.9 GHz turbo, 18 core, or better
RAM	64 GB or more
Disk	512 GB SSD or more

About us

LAP is one of the world's leading suppliers of systems that increase quality and efficiency through laser projection, laser measurement, and other processes. Every year, LAP supplies 15,000 units to customers in industries as diverse as radiation therapy, steel production, and composite processing. LAP employs 300 people at locations in Europe, America and Asia.

LifeLine Software, Inc., the developer of RadCalc, is part of the LAP Group. We are driven to improve the lives of those who fight cancer. We help to assure that they are receiving quality treatments. Our goal is to create the highest quality software products. We strive to achieve this goal by our commitment and dedication to continuous improvement of all we do in responding to the needs of our customers for the benefit of the patients and families they serve.

In order to achieve this vision, we look for associates and business partners who share our passion to serve others through their hard work and dedication to excellence in all they do every day. We do our best to create a work environment that encourages our associates to listen to their customers, both inside and outside our company and to deliver results with integrity.

RadCalc is our commitment to responding to the needs of Radiation Oncology health care providers by contributing to the enhancement of the quality of their work, and to the quality of life of their patients. RadCalc was developed by our board-certified physicist to make independent Dosimetric calculation verification accurate, quick, and easy.

Request a demo

We are ready to build your RadCalc QA package customized to your specific needs. Please contact our sales teams worldwide.

P +1 866 592 1343
E info@lap-laser.com

Contact us!

P +1 866 592 1343
E info@lap-laser.com
LAP Laser
laplaser

LAP GmbH Laser Applikationen
Zeppelinstr. 23
21337 Lüneburg
Germany

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