



VERIQA

The Modular Software Platform
for Comprehensive Patient QA



VERIQA

The modular software platform for comprehensive Patient QA

One platform. Flexible and scalable.

From visualization and evaluation to verification and reporting, VERIQA is an all in one software built on future-proof client-server architecture.

Track. Trend. Monitor.

Track and analyse your results with the automated integration of Track-it.

Automated plan verification

VERIQA gives you the ability to select the best method for specific verification needs. Choose between independent dose calculations, pre-treatment and in vivo EPID dosimetry, log file analysis, and phantom based measurements with OCTAVIUS® 4D, or any combination thereof.

Automated workflows. Streamlined operations.

Take your workflow efficiency to the next level by automating your patient-specific quality assurance.

Monte Carlo dose calculations: Fast and precise.

VERIQA calculates dose using the well-established SciMoCa™ Monte Carlo algorithm known for its accuracy and reliability. Use this gold standard method to automatically evaluate your treatment plans with minimum effort in 3D.

Advanced 3D EPID Dosimetry

Based on the clinically proven algorithm, the VERIQA RT EPID 3D is the new Patient QA module to come for true 3D pre-treatment and in vivo EPID dosimetry. Since 2005, the algorithm has been successfully used in more than 75,000 patient treatments at The Netherlands Cancer Institute, Antoni van Leeuwenhoek Hospital (NKI-AVL).

VERIQA Platform Overview

Powerful Patient QA modules integrated in a single platform



Treatment plan visualization
DICOM RT Viewer for detailed plan review and comparison



Treatment plan evaluation
DICOM RT toolset for enhanced treatment plan analysis



Pre-treatment verification
Independent 3D dose calculation and phantom measurements



Treatment delivery verification
Independent 3D dose calculation using linac log files or EPID images

| | | | |
|---------|-------------|------------------|----------|
| RT View | | | |
| | RT Evaluate | | |
| | | RT MonteCarlo 3D | |
| | | RT EPID 3D | |
| | | RT Log | |
| | | RT OCTAVIUS® | |
| | | | RT Adapt |

■ released ■ upcoming ■ planned

Your advantages:

- ▶ **Independent**
Uses clinically proven, independent 3D dose verification tools and calculation algorithms for reliable results regardless of treatment complexity
- ▶ **Automated**
Fully automated workflows for verification, evaluation, and documentation, which means better use of machine and staff resources with minimum user interaction
- ▶ **Modular**
Flexibility to select and combine patient QA methods by simply adding VERIQA modules
- ▶ **Integrated**
One single, easy-to-access, web-based platform for all patient QA tasks in pre-treatment and delivery verification

Testimonials



“ VERIQA is extremely suitable, dynamic and efficient. It offers an excellent solution for independent plan verification, with a high-quality dose calculation. We believe it is important to establish appropriate tolerance and action levels for the use of VERIQA. ”

Dr. Vicente Carmona
Medical Physicist, Hospital Universitari i Politècnic La Fe, Valencia



“ For us VERIQA is an easy to handle, very useful and helpful software tool for secondary dose calculation. ”

Rodrigo Lope Lope
Medical Physicist, Hospital Universitario Araba, Vitoria-Gasteiz

VERIQA streamlined workflow

Data Import

VERIQA receives and collects data from TPS and linacs and automatically starts the QA Workflow.

Results

Results can be directly accessed via web browser and exported to RT View/Evaluate for further analysis and comparison.

Documentation

Multiple options are available to document the results: PDF report, DICOM export to PACS, Track-it export



Calculation

VERIQA automatically recalculates and compares dose based on settings in assigned evaluation templates and sends email notifications as soon as the task is completed.

Approval

Results are automatically evaluated based on user defined criteria and can be approved or rejected by authorized users. Comments can be added to each important step of the verification process, ensuring full traceability of the results.

VERIQA RT MonteCarlo 3D workflow demo



Get to know VERIQA and experience the software on our website. Find numerous workflow screencasts that guide you through important functions and features of VERIQA.

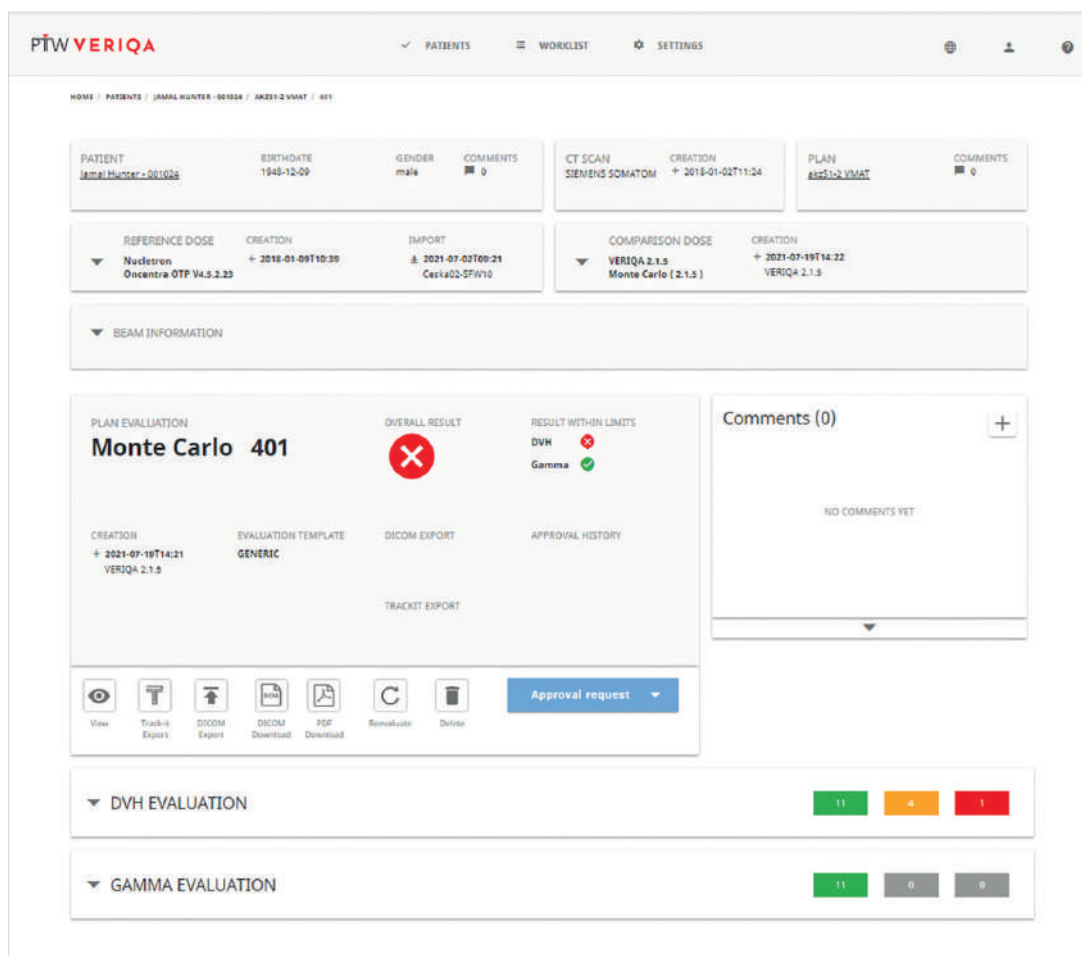


Scan this QR code to directly access our workflow demo



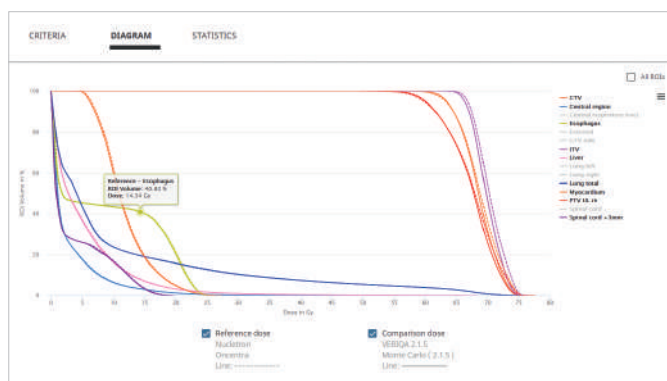
Scan this QR code to talk to our experts or book a live demo. Find out how VERIQA can help to improve workflow efficiency and quality in patient QA.

VERIQA – Clear structure. Intuitive design.

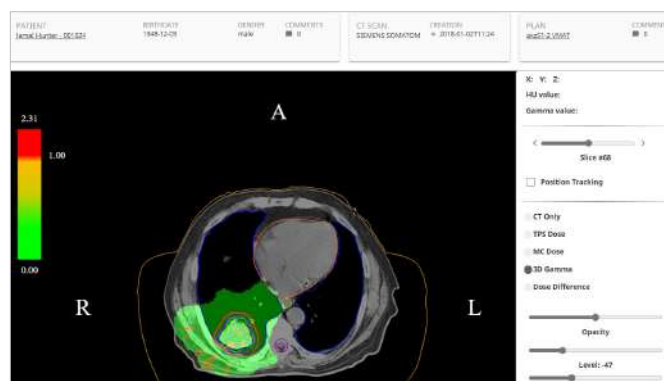


Review evaluation results at a glance:

The clear structure and intuitive design of VERIQA helps you to efficiently review your QA results. The evaluation results are color-coded to make them easy to read. Passed or failed results can thus be immediately identified. Important results are provided on a single page and can be accessed with one click from an automated email notification. The overall result helps summarize ROI specific DVH and Gamma evaluations and track the outcome of plan verification.



Easy and intuitive access to results: Analyze the criterion-based plan evaluation results as a volume histogram or as a statistical overview of dose metrics, ROI-by-ROI.



Visualize dose and gamma distributions directly with the web-based viewer: VERIQA offers an integrated slice viewer to easily visualize CTs, ROIs, doses, dose differences and 3D gamma distributions.

VERIQA RT MonteCarlo 3D

Secondary Monte Carlo 3D dose calculation. Accurate. Fast. Automated.

Monte Carlo techniques are the gold standard for dose calculation in radiotherapy. VERIQA RT MonteCarlo 3D calculates doses using the well-known, clinically proven SciMoCa Monte Carlo algorithm for dose verification. VERIQA is independent from LINAC vendors and treatment planning systems, thus allowing a truly independent dose verification

calculation. As part of the VERIQA patient QA platform, VERIQA RT MonteCarlo 3D offers a fully automated dose verification with both speed and accuracy. Thus enhancing safety and increasing efficiency simultaneously in daily patient QA. Highly accurate calculation results are available in just a few minutes.

Accurate

Monte Carlo simulations are the most accurate method for dose calculation in radiotherapy treatment planning. With its ability to simulate the physics of photons and charged particles transport through matter, Monte Carlo can accurately compute the dose under almost any circumstances.

The advanced algorithm of VERIQA RT MonteCarlo 3D achieves a perfect balance between efficiency and accuracy.

Fast

VERIQA RT MonteCarlo 3D has been specifically designed for fast, accurate dose verification calculations in megavoltage external beam radiotherapy. With VERIQA's advanced algorithm and unique virtual source modeling, it is superior in speed, efficiency and minimizing non-Gaussian noise. Due to the streamlined workflow, calculations run in the background with no user interaction required.

Integrated

RT MonteCarlo 3D is a fully integrated module of the VERIQA patient QA platform, which automates workflows and streamlines all operations, requiring minimum user interaction.

Calculation results within 2 minutes

VERIQA RT MonteCarlo 3D comes pre-installed on a powerful server, allowing for high-speed dose computations. Calculation results are available in less than 2 minutes (under common clinical conditions).

Automated

Triggered by the transfer of treatment plans to VERIQA, RT MonteCarlo 3D knows what to do and will take care of all tasks – from calculation and evaluation to notification and documentation.

Independent

Due to its specific beam modelling process, which is based on water phantom measurements, VERIQA RT MonteCarlo 3D performs truly independent dose calculations for a reliable secondary plan check.

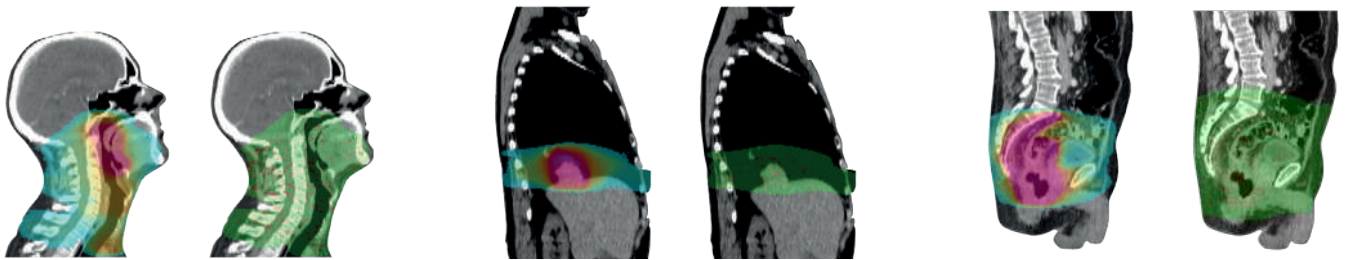


Scan the QR code for more information about VERIQA RT MonteCarlo 3D.

Clinically proven accuracy

VERIQA RT MonteCarlo 3D builds on the SciMoCa™ Monte Carlo dose engine which was specifically designed to efficiently calculate radiation treatment dose for plan QA planning purposes. SciMoCa™ derives from the EGSnrc/XVMC/VMC++ Monte Carlo code family. It keeps deviations in the toughest artificial situations to a maximum of 2% compared

to general purpose Monte Carlo codes. Due to its unique virtual beam modelling and optimized use of sophisticated variance reduction techniques, it maximizes efficiency and minimizes non-Gaussian noise. The algorithm was benchmarked in numerous publications against measurements and dose calculation.



98% GPR*

99% GPR*

99% GPR*

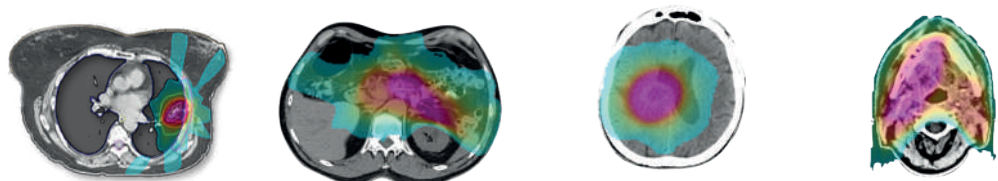
* Gamma Passing Rate, 2 % / 2 mm, global

VERIQA RT MonteCarlo 3D plan evaluations of three VMAT treatment plans calculated with Acuros XB (v 13.7, Varian Medical Systems). Outstanding agreements with differences below common experimental detection thresholds for clinical treatment plans (results from Hoffmann et al. Medical Physics Volume 45, Issue 8, 2018).

Exceptional speed

VERIQA RT MonteCarlo 3D combines highest speed and accuracy. The graphics show an example of the calculation time needed by a VERIQA RT MonteCarlo 3D server as delivered by PTW. The calculation time of a Monte Carlo simu-

lation depends on dose grid size, statistical uncertainty, and the complexity of the simulation. Even in the most difficult cases, however, VERIQA RT MonteCarlo 3D simulations are completed in just a few minutes.



LUNG SBRT

Pancreas

Brain

Head and neck

3D / 7 beams
6 MV FFF

VMAT / 2 arcs / 180 CP¹
6 MV - SIB²

VMAT / 1arc / 90 CP¹
6 MV FFF

VMAT / 2arc / 180 CP¹
6 MV - SIB²

| | | | | |
|-------------------------|-----------------------|------------------------|------------------------|------------------------|
| PTV volume | 46.45 cm ³ | 589.26 cm ³ | 264.48 cm ³ | 907.74 cm ³ |
| Dose grid size | 3 x 3 x 3 mm | 3 x 3 x 3 mm | 2 x 2 x 2 mm | 2 x 2 x 2 mm |
| MC accuracy | 1 % | 1 % | 0.5 % | 0.5 % |
| Calculation time | 12 sec | 30 sec | 46 sec | 246 sec |

Calculated on a dual 12-core Intel Xeon Silver 4214 2.2 GHz server with hyperthreading (48 logical cores)

Optimize the frequency of dose measurements and save time for more important tasks

VERIQA RT MonteCarlo 3D does not require machine time or additional effort to perform phantom measurements

< 2 %

SciMoCa™'s excellent dose calculation accuracy matches the best in class dose calculation algorithms like Varian Acuros® XB

2 min

Time needed for independent 3D dose calculation and evaluation of a typical clinical IMRT treatment plan*

5 x

Faster than measurement-based 3D dose verification: 2 minutes compared to 10 minutes for phantom measurements*

120 hrs

Can be saved annually on patient QA time if 75 % of treatment plans are verified using VERIQA RT MonteCarlo 3D instead of phantom measurements.*

*Based on clinical feedback: 1200 plan evaluations per year, measurement time: 10 min, calculation time: 2 min

Setting new standards in Patient-QA

1

Catch errors already in the treatment planning process

VERIQA RT MonteCarlo 3D is a secondary 3D dose calculation module for pre-treatment plan verification. Providing an independent secondary dose check of the treatment plan makes VERIQA an ideal tool to identify errors in treatment planning.

2

Complementary measurement-based patient QA approach

VERIQA RT MonteCarlo 3D allows for separation of measurements and delivery errors from errors in treatment planning. Use its power and speed to efficiently perform a secondary 3D dose calculation for every treatment plan, as recommended by the AAPM Task Group 219.

3

Implement valuable Monte Carlo dose calculation into your QA workflow

Utilize the unique advantages of high-quality RT MonteCarlo 3D dose calculations. While phantom measurements neglect the patient anatomy, Monte Carlo is evidently the best solution to include accurately heterogeneous anatomies into your patient-QA. Monte Carlo has an inherent accuracy that is superior to any other analytical algorithm. Only this accuracy ensures the highest sensitivity to catch errors and the ability to define clinically relevant, patient-centered evaluation criteria.

4

Benefit from expert-based beam models

VERIQA's beam models are not standard – they are precise. Benefit from the unique, expert-based beam modelling process assuring high-end dose calculation.

All VERIQA beam models are created linac and customer specific by experienced PTW physicists using water phantom measurements. While other secondary dose calculation tools apply obsolete dose calculation algorithms with substandard beam model accuracy, VERIQA RT MonteCarlo 3D can reach true TPS-equivalent dose quality.

5

Rely on accuracy without limits

In complex situations, such as stereotactic treatments, measurement equipment can be limited in terms of positioning and measurement errors. VERIQA RT MonteCarlo 3D offers the unique combination of outstanding dose performance in heterogeneous anatomies and highly accurate beam model quality, without any limits in geometrical precision for small fields.

Publications could show that secondary Monte Carlo dose calculation with high-quality beam models can be an excellent alternative to phantom measurements in stereotactic radiotherapy.

6

Be truly independent

Secondary dose calculation tools should be completely independent of the treatment planning system to reliably detect clinically relevant errors. Independency from the TPS must be assured for the dose calculation algorithm and the dosimetric input data for beam modelling.

Scan the QR codes below for more information on points 2, 3, and 5

2



3



5





Testimonials



“ In practice, Monte Carlo dose calculation is only as accurate as the specific beam model for the customer’s linac. SciMoCa™ was born from the belief that we can master this challenge for every customer. ”

Prof. Dr. Markus Alber
ScientificRT GmbH, Munich



“ Secondary dose calculation systems should be completely independent from primary TPS. Accurate matching between the secondary dose calculational systems and the dosimetric characteristics of the linac is thereby essential for truly independent and valuable dose evaluation. ”

Prof. Sotiri Stathakis, Ph.D.
University of Texas Health Science
Center, San Antonio

Supported systems

Treatment machines

Varian

All C-arm based LINACs, including all MLC types and beam energies, Halcyon™ platform 6MV FFF

Elekta

All C-arm based LINACs, including all MLC types and beam energies

Accuray

CyberKnife®: all models, fixed diameter cones, IRIS, MLC-type InCise 2

TomoTherapy®

Hi-Art®, Radixact®

Standard beam models

Varian: Halcyon™, TrueBeam®

Elekta: Versa HD™

Accuray: TomoTherapy®

Treatment modes

All common treatment techniques, including: 3D, Wedges, IMRT, Arcs & VMAT, SBRT, SRS

Treatment planning systems

Any TPS capable of DICOM-RT export

VERIQA RT EPID 3D

True 3D EPID dosimetry.
Pre-treatment. In vivo. Fully automated.

EPID dosimetry is gaining more and more attention in modern radiation therapy because of its time saving, easy to use pre-treatment Patient QA and ability to in vivo treatment verification. As part of the VERIQA Patient QA platform, VERIQA RT EPID 3D provides a fully automated solution for

both pre-treatment and in vivo EPID dosimetry enabling true 3D patient dose reconstruction from the acquired images. The RT EPID 3D module is currently under development.

True 3D patient dosimetry

Unlike most EPID dosimetry solutions, VERIQA RT EPID 3D enables a true 3D dose verification from the acquired EPID images by reconstructing the dose in the patient anatomy. This feature offers a significant clinical advantage of comparing the EPID-reconstructed dose directly to the planned patient dose as well as the calculation of patient dose-volume histograms (DVHs) for both pre-treatment and in vivo dosimetry.

Pre-treatment: Phantomless and efficient

VERIQA RT EPID 3D enables the reconstruction of a 3D patient dose distribution from EPID images acquired "in air" with no need for phantom set-up or re-planning. Thus creating a truly patient-specific pre-treatment QA while increasing efficiency.

Clinically proven

The back-projection algorithm of VERIQA RT EPID 3D is a clinically proven and well-established method, which has been successfully used at The Netherlands Cancer Institute - Antoni van Leeuwenhoek Hospital (NKI-AVL) in more than 72,000 patient treatments since 2006. Numerous peer-reviewed publications prove the accuracy of the algorithm and show the clinical benefit of using EPID-based pre-treatment and in vivo dosimetry.

Fully automated

One of the greatest achievements of VERIQA RT EPID 3D is the high degree of automation, which keeps user interactions at a minimum. Once a treatment plan has been sent to VERIQA, VERIQA RT EPID 3D will automatically import and assign corresponding EPID images. Whether its calculation and evaluation or notification and documentation, VERIQA knows exactly what to do.

In vivo: Catching clinically relevant errors

VERIQA RT EPID 3D enables in vivo reconstruction of the dose delivered to the patient from EPID images acquired during patient treatment. This makes it possible to not only detect unnoticed clinically relevant errors during pre-treatment verification, but also to quantitatively assess their dosimetric impact.

Fullfilling quality standards and legal requirements

VERIQA RT EPID 3D makes it very easy to comply with high quality standards for the dosimetry of advanced treatment techniques and at the same time fullfill legal requirements of in vivo dosimetry, which are expected to be adopted by more and more countries in the future.



“The VERIQA module RT EPID 3D is like a Swiss army knife: it delivers a fast patient QA solution and provides your radiotherapy treatment chain with an extra safety net.”

Dr. Anton Mans
 Medical physicist, Radiation Oncology
 Department of The Netherlands Cancer
 Institute - Antoni van Leeuwenhoek
 Hospital (NKI-AVL), Amsterdam



“The EPID dose back-projection algorithm of VERIQA RT EPID 3D will offer a double benefit. It will verify treatment delivery by using in vivo EPID measurements as well as increase efficiency in pre-treatment verification by using EPID images acquired “in air”, thus eliminating the need for phantom positioning and re-planning.”

Igor Olaciregui
 Software & Physics Lead, The Netherlands
 Cancer Institute - Antoni van Leeuwenhoek
 Hospital (NKI-AVL), Amsterdam

Advanced 3D back-projection approach

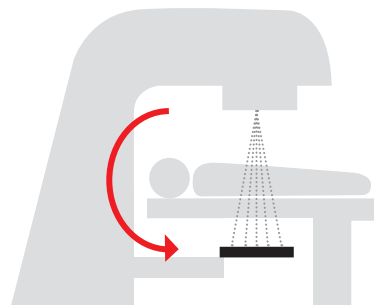
VERIQA RT EPID 3D builds on the well-established back-projection algorithm developed by The Netherlands Cancer Institute – Antoni van Leeuwenhoek Hospital (NKI-AVL) for dose reconstruction refined by a unique Monte Carlo-based inhomogeneity correction (patent pending), offering significant clinical advantages. Unlike most EPID dosimetry solutions using the so called forward approach, VERIQA RT

EPID 3D enables a true 3D dose verification from the acquired EPID images by accurately reconstructing the dose in the patient anatomy. This enables direct comparison with the planned patient dose and the use of clinically relevant comparison metrics such as patient dose-volume histograms (DVHs) for all treatment sites including those with significant tissue heterogeneities.

Forward approach*

Current standard of commercial products

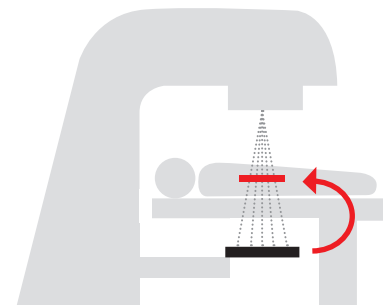
- 1 EPID images are acquired during patient treatment
- 2 Treatment plan is used to forward calculate/predict EPID images
- 3 Measured EPID images are compared against predicted EPID images



Back-projection approach*

Used in
VERIQA RT EPID 3D

- 1 EPID images are acquired during patient treatment
- 2 EPID measured dose is back-projected into patient
- 3 Reconstructed patient dose is compared against planned dose

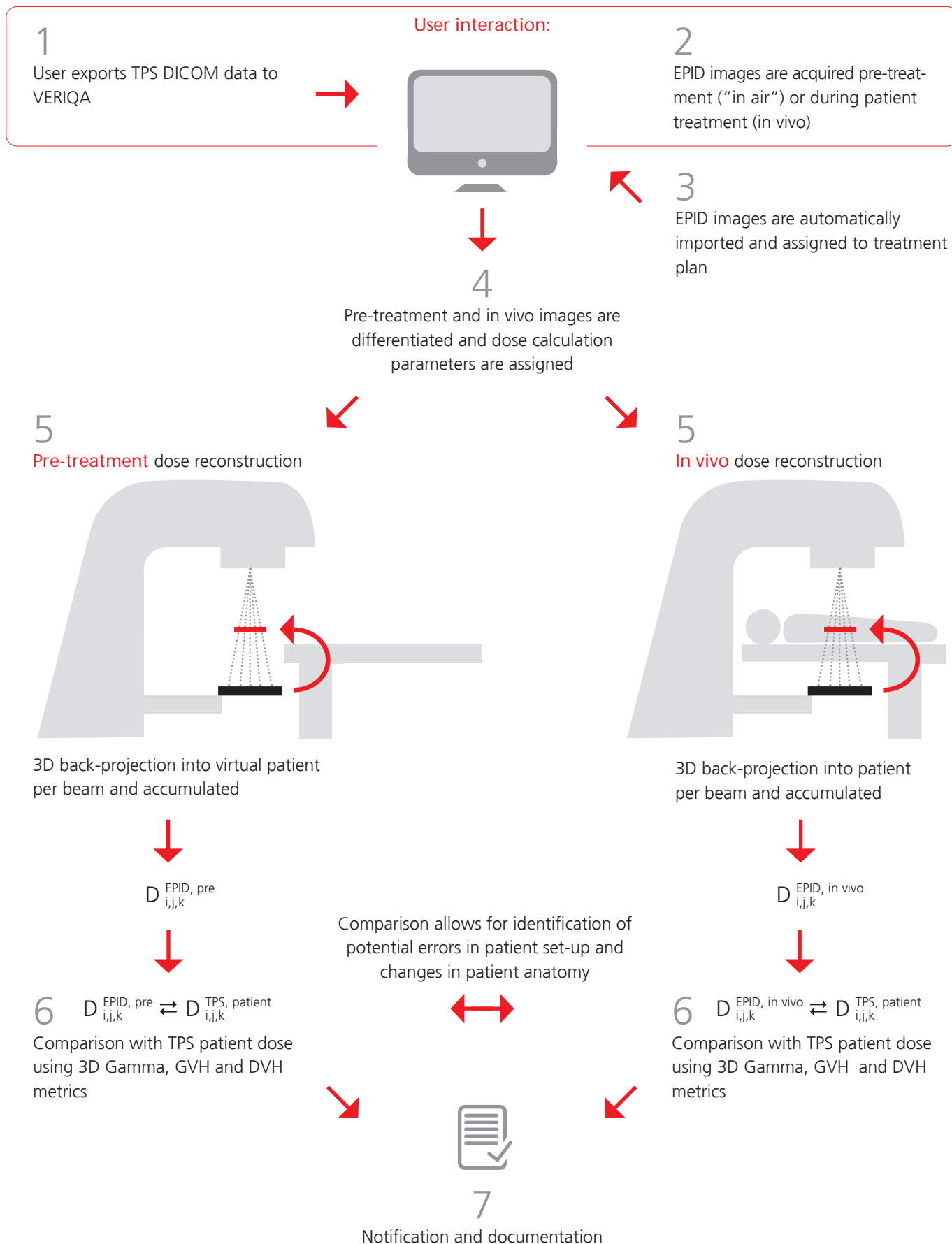


| Comparison level | EPID | Patient |
|--------------------|--|--------------------|
| Reference | Predicted EPID image/dose distribution | TPS |
| Visualization | 2D only | 3D |
| Comparison metrics | 2D Gamma | 3D Gamma, GVH, DVH |

* For simplicity, the comparison of forward-projection and back-projection approach is explained using the example of in vivo EPID dosimetry. However, the same concept holds true for EPID-based pre-treatment dosimetry.

Automation

VERIQA RT EPID 3D uses the synergy of a single algorithm for pre-treatment and in vivo dosimetry. User interaction is only needed in step 1 and 2 - all other steps are taken care of by VERIQA RT EPID 3D.



Platform integration

VERIQA RT EPID 3D adapts seamlessly into the modular structure of VERIQA and expands the Patient QA platform to the verification of each treatment delivery. The trend of the EPID-reconstructed patient dose over the course of treatment

is comprehensively presented per treatment plan. This ensures clear overview of the entire treatment and allows easy access to further evaluation results of individual fractions.

The screenshot displays the PTW VERIQA software interface. At the top, there are navigation tabs for PATIENTS, WORKLIST, and SETTINGS. The main content area is divided into several sections:

- Patient Information:** Includes fields for PATIENT (Hans Mustermann - 00013), BIRTHDATE (1982-04-05), GENDER (Male), COMMENTS (3), CT PROTOCOL (CT_PROTOCOL_LUNG), STATION (SIEMENS_CT1), PLAN (Lung_Y1), and COMMENTS (0).
- Task Details:** Shows TASK (EPID Lung), TYPE (EPID), and a RESULT SUMMARY with a bar chart showing 5 green bars and 1 red bar.
- Task Overview Table:** A table with columns: ACQUISITION, EVALUATION, RESULT, GAMMA DISTRIBUTION (Transverse | Sagittal | Coronal), DVH EVALUATION, GAMMA EVALUATION, BEAMS USED, APPROVAL, and COMMENTS. The table lists five EPID tasks (EPID 1 to EPID 5) with their respective dates, times, and status indicators (green checkmarks, yellow exclamation marks, or red X's).

Selected publications

- ▶ Olaciregui-Ruiz et al. *Transit and non-transit 3D EPID dosimetry versus detector arrays for patient specific QA.* J Appl Clin Med Phys, 1-12 (2019)
- ▶ Olaciregui-Ruiz et al. *Site-specific alert criteria to detect patient-related errors with 3D EPID transit dosimetry.* Med Phys 46, 45-55 (2019)
- ▶ Olaciregui-Ruiz et al. *Virtual patient 3D dose reconstruction using in air EPID measurements and a back-projection algorithm for IMRT and VMAT treatments.* Phys Med 37, 49-57 (2017)
- ▶ Mijnheer et al. *Overview of 3-year experience with large-scale electronic portal imaging device-based 3-dimensional transit dosimetry.* Pract Radiat Oncol 5, e679-e687 (2015)
- ▶ Mans et al. *3D Dosimetric verification of volumetric-modulated arc therapy by portal dosimetry.* Radiother Oncol 94, 181-187 (2010)
- ▶ Wendling et al. *A simple backprojection algorithm for 3D in vivo EPID dosimetry of IMRT treatments.* Med Phys 36, 3310-3321 (2009)
- ▶ Wendling et al. *Accurate two-dimensional IMRT verification using a back-projection EPID dosimetry method.* Med Phys 33, 259- 273 (2006)

VERIQA RT View



Independent solution for enhanced visualization and image analysis in radiotherapy

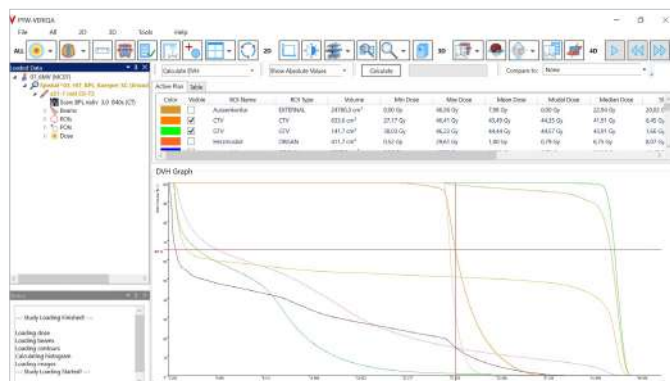
VERIQA RT View is a universal solution for the visualization of radiotherapy plans, designed to assist you in plan review. It provides quick and easy access to radiotherapy planning data and enables uniform viewing of radiation treatment plans

independent of the treatment planning system. As a versatile software, VERIQA RT View comes with powerful tools for interactive visualization and plan comparison.

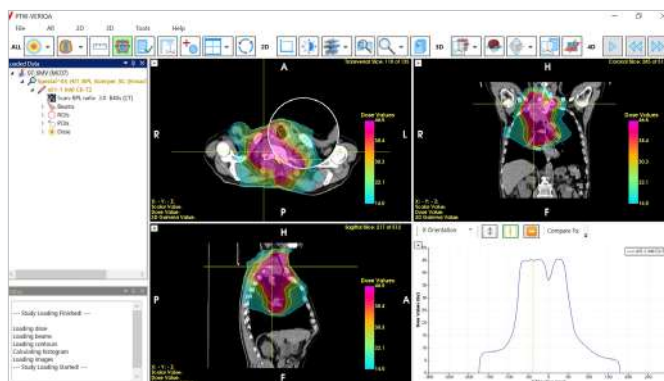
Your advantages

- ▶ Comprehensive software toolbox for advanced visualization and image analysis
View treatment plans and images from different sources in one place.
- ▶ Independent solution
Access and review all treatment planning data from any PC in your network.
- ▶ DICOM-based
Benefit from a vendor-neutral, future-proof platform, meeting legal requirements for long-term data archiving and retrieval.

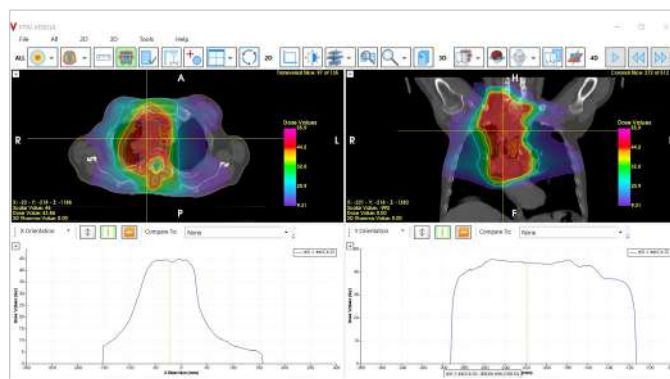
2D/3D/4D data visualization and plan comparison



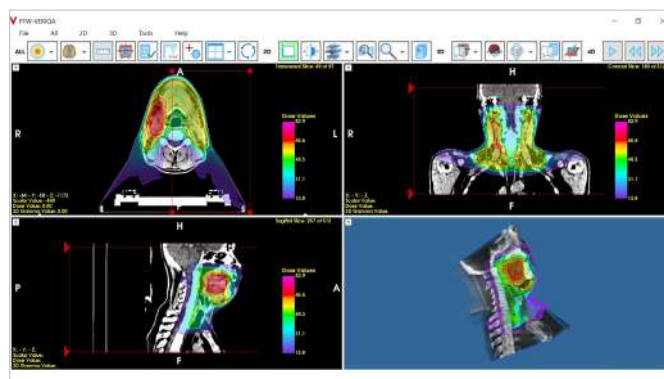
Calculation and comparison of DVHs



Magnification of selected regions



Dose profile plotting



Volume cropping

VERIQA RT Evaluate



Independent solution for radiotherapy treatment plan evaluation

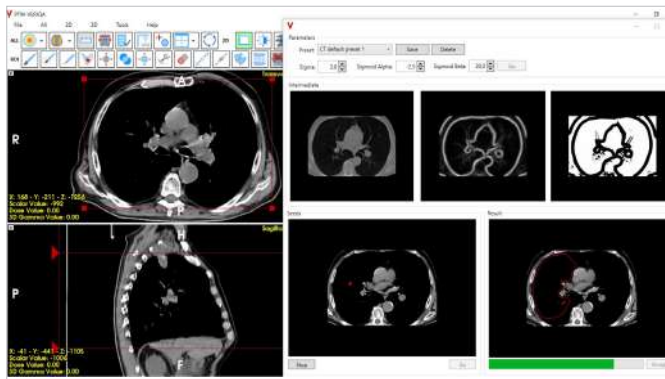
VERIQA RT Evaluate is the perfect addition to RT View, providing you with advanced tools for treatment plan analysis. It comes with a set of useful tools and powerful functions for rapid contouring and enables further plan evaluation by

offering rigid and deformable image registration. Investigate dose differences in detail by applying dose accumulation or 3D gamma comparison.

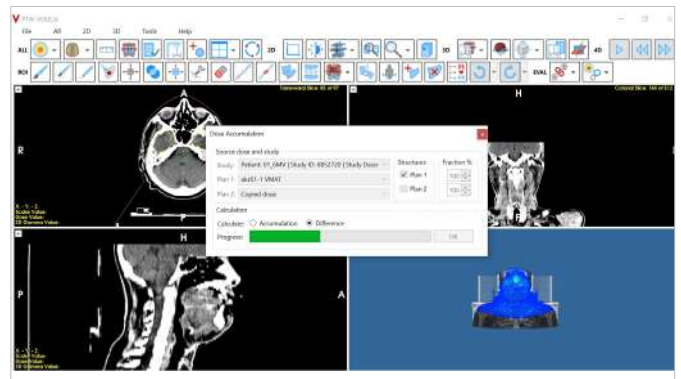
Your advantages

- ▶ **Versatile RT toolbox**
Combined with RT View, RT Evaluate offers an integrated, independent RT imaging solution for radiation oncology departments.
- ▶ **Advanced plan evaluation**
Gain access to advanced plan visualization and evaluation tools, including rigid and deformable image registration, dose summation and 3D gamma analysis.
- ▶ **Easy and smart contouring**
Benefit from a comprehensive set of contouring functionalities - from manual painting tools and ROI algebra to semi- and fully automatic contouring.

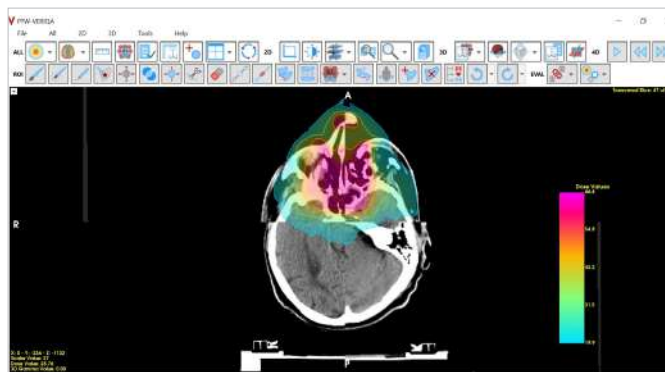
Powerful visualization tools for plan evaluation



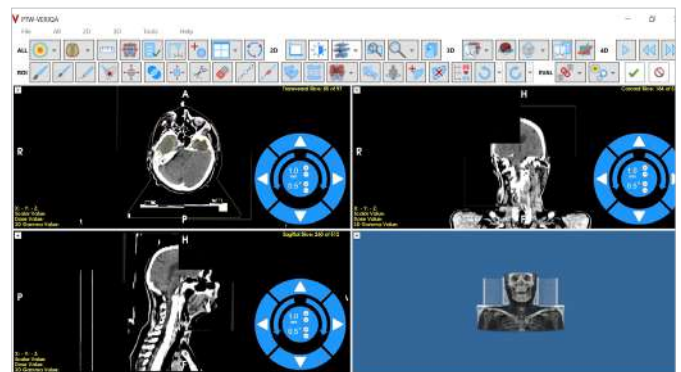
Auto contouring based on grey value and edge detection



Dose accumulation and calculation of dose differences



Overlaid view for image registration



Rigid and deformable registration

Patient QA Modular Track-it EPID

Efficient OCTAVIUS 4D Log files Confident

Proven **VERIQA** SciMoCa™
Monte Carlo PTW quality

Workflow orientated Simplified documentation

In vivo dosimetry Full automatization

Secondary dose check

Making Radiation Safer.

PTW is a global market leader for dosimetry and quality control solutions in radiation medicine, serving the needs of medical radiation experts in more than 160 countries worldwide. Starting with the famous Hammer dosimeter in 1922, the German manufacturer is the pioneer in medical radiation measurement, known for its unparalleled quality and precision.

For PTW, making medical radiation safer is both a passion and lifetime commitment. The family-run high-tech company operates the oldest and largest accredited calibration laboratory in the field of ionizing radiation and established THE DOSIMETRY SCHOOL to globally promote the exchange of knowledge in clinical dosimetry.

For more information on VERIQA visit ptwveriqa.com
or contact your local PTW representative:
ptwdosimetry.com/en/contact-us/local-contact

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D952.139.06/02 2023-01

**PTW**
THE
DOSIMETRY
COMPANY